Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

OCTOBER, 1953

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TECHNOLOGY DEPT.

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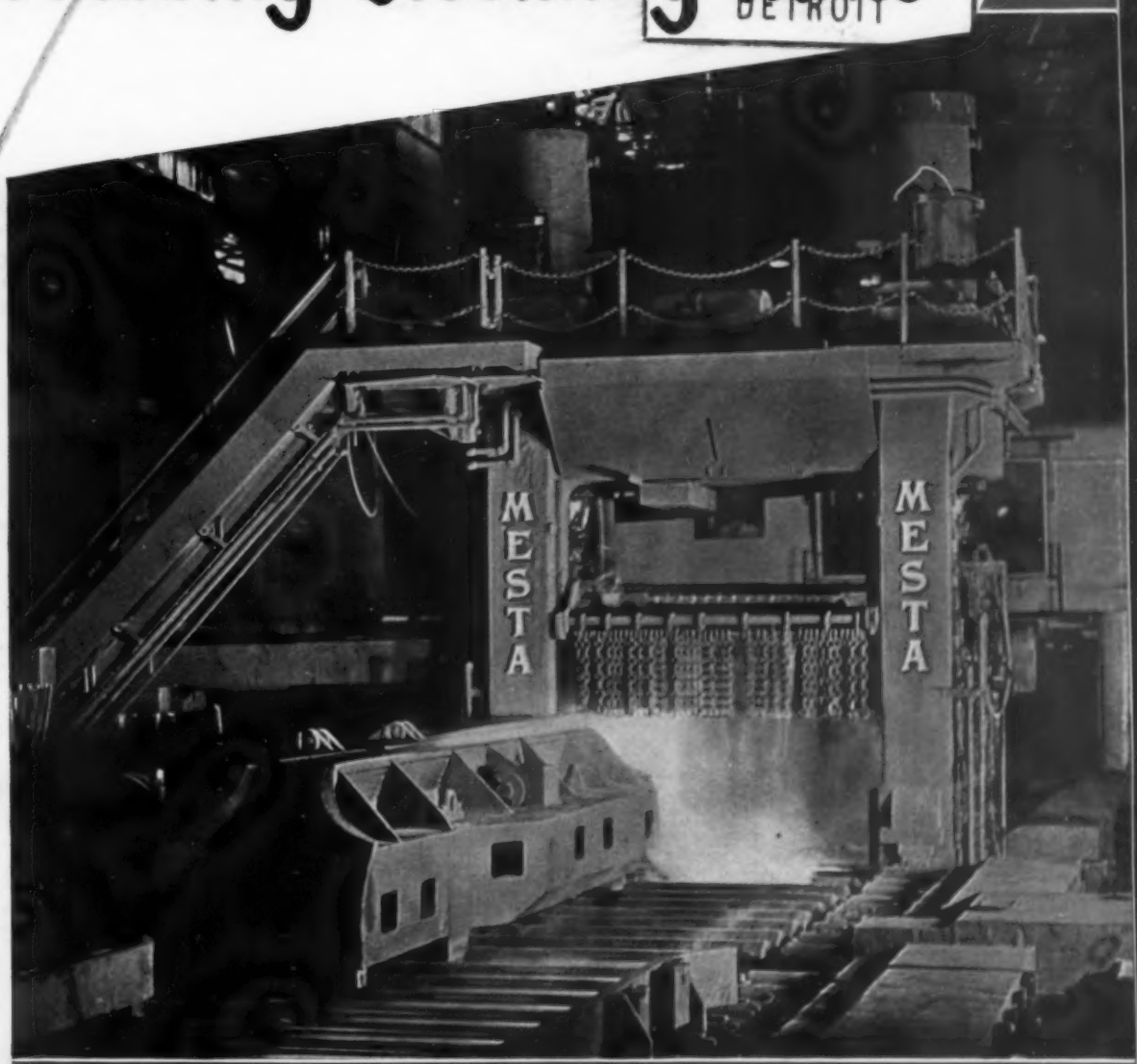
DETROIT

Modern Reversing Slabbing-Blooming Mills

Designed and Built by

MESTA



MESTA 46" Reversing Slabbing-Blooming Mill
Installed at the Pittsburgh Works of the Jones and Laughlin Steel Corporation

Designers and Builders of Complete Steel Plants

MESTA MACHINE COMPANY, Pittsburgh, Pa.

THE THREE CUTLER-HAMMER STARS ★ ★ ★

STAND FOR THREE NEW STANDARDS

Installs easier

The cost of installing motor control today is usually much more than the cost of the control equipment, often two to three times as much. Thus this new control offers *large* savings.

Works better

Users say, "Nothing like this ever before." Smooth, quiet operation with uniform response. New adjustable overload protection lets motors work harder with fewer nuisance interruptions.

Lasts longer

Revises all existing ideas of long trouble-free life in motor control. Cuts rate of wear to point that maintenance care and cost are virtually eliminated for 90% of all control uses.

Look for the three silver stars on the famous Cutler-Hammer nameplate; they identify the new spectacular Cutler-Hammer ☆☆☆ Motor Control. These three stars stand for three entirely new standards in motor control satisfaction and value. ☆ 1 . . . Easier, faster, lower cost installation any electrician can readily prove. ☆ 2 . . . Time-saving, trouble-saving, cost-cutting better performance which any test will confirm. ☆ 3 . . . Amazingly longer life due to advanced engineering features anyone can understand. Compare it by features and by performance. You too will say it is the finest control you know. CUTLER-HAMMER, Inc., 1269 St. Paul Avenue, Milwaukee 1, Wisconsin.

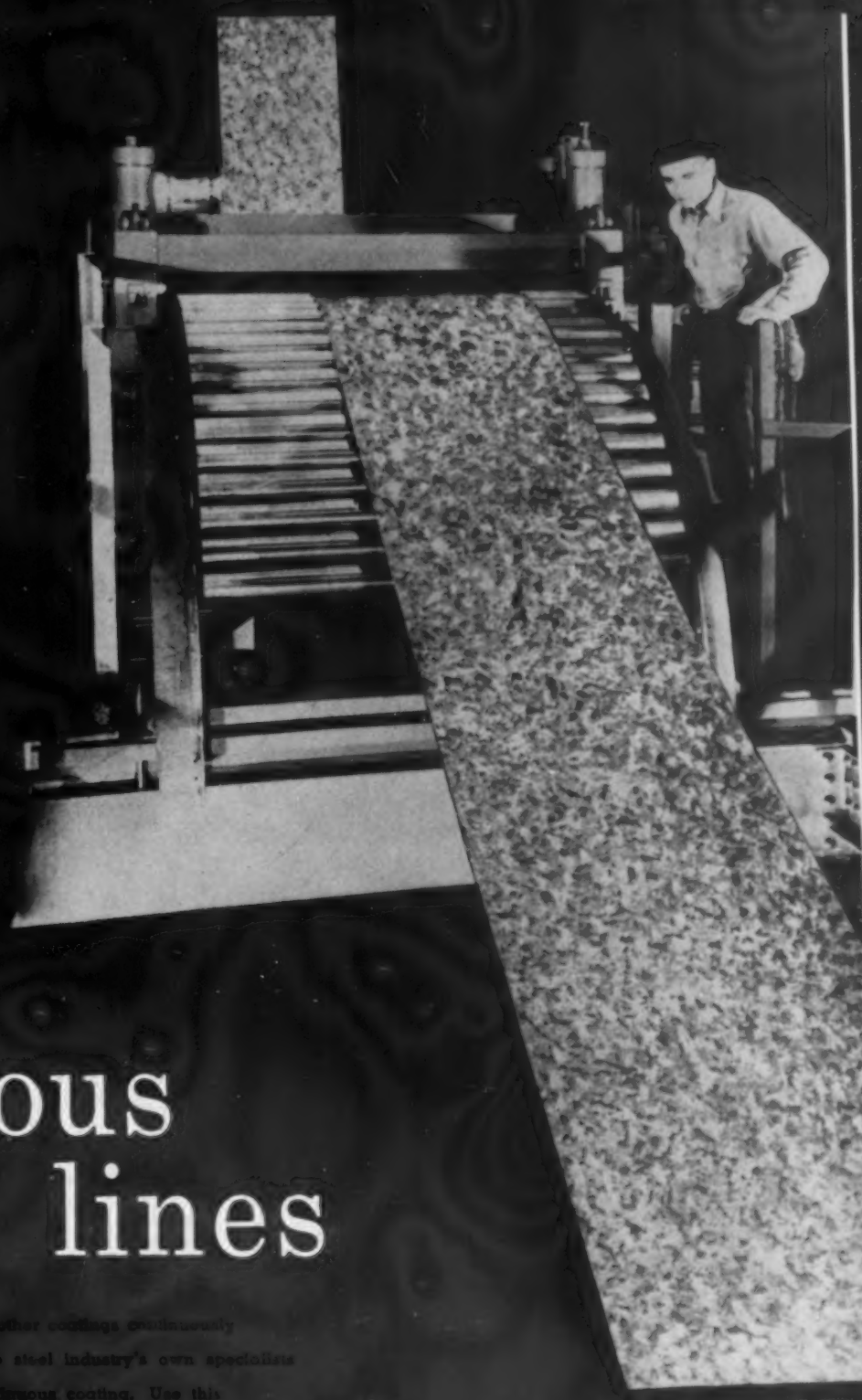
TRY IT !
COMPARE IT !
TEST IT !
PROVE IT !

Order from your nearby Authorized Cutler-Hammer Distributor today.

CUTLER-HAMMER ★★★ MOTOR CONTROL

IRON AND STEEL ENGINEER; published monthly by Association of Iron and Steel Engineers, 1010 Empire Bldg., entered as second class matter January 25, 1924 at Pittsburgh, Pennsylvania, under Act of Congress, March 3, 1879. $7.50 per year in United States and Canada. $10.00 foreign countries. Volume 30, No. 10.

GOOD EQUIPMENT BRINGS DOWN PRODUCTION COSTS



continuous coating lines

The application of galvanizing, terne and other coatings continuously in coils has arrived. Aetna's engineers and the steel industry's own specialists have worked closely in developing continuous coating. Use this experience and practical knowledge when you consider Continuous Coating Lines for your business.

In recent months, Aetna-Standard has completed four new galvanizing and terne lines for important steel companies. These installations include primary and auxiliary equipment.

THE AETNA-STANDARD ENGINEERING COMPANY • PITTSBURGH, PA.

Aetna-Standard

PLANTS IN WARREN, OHIO • ELLWOOD CITY, PENNSYLVANIA

ASSOCIATED COMPANIES

Designers and Builders to the Ferrous, Non-Ferrous, Leather and Rubber Industries

Inspecting a roll

A HARD MAN TO PLEASE

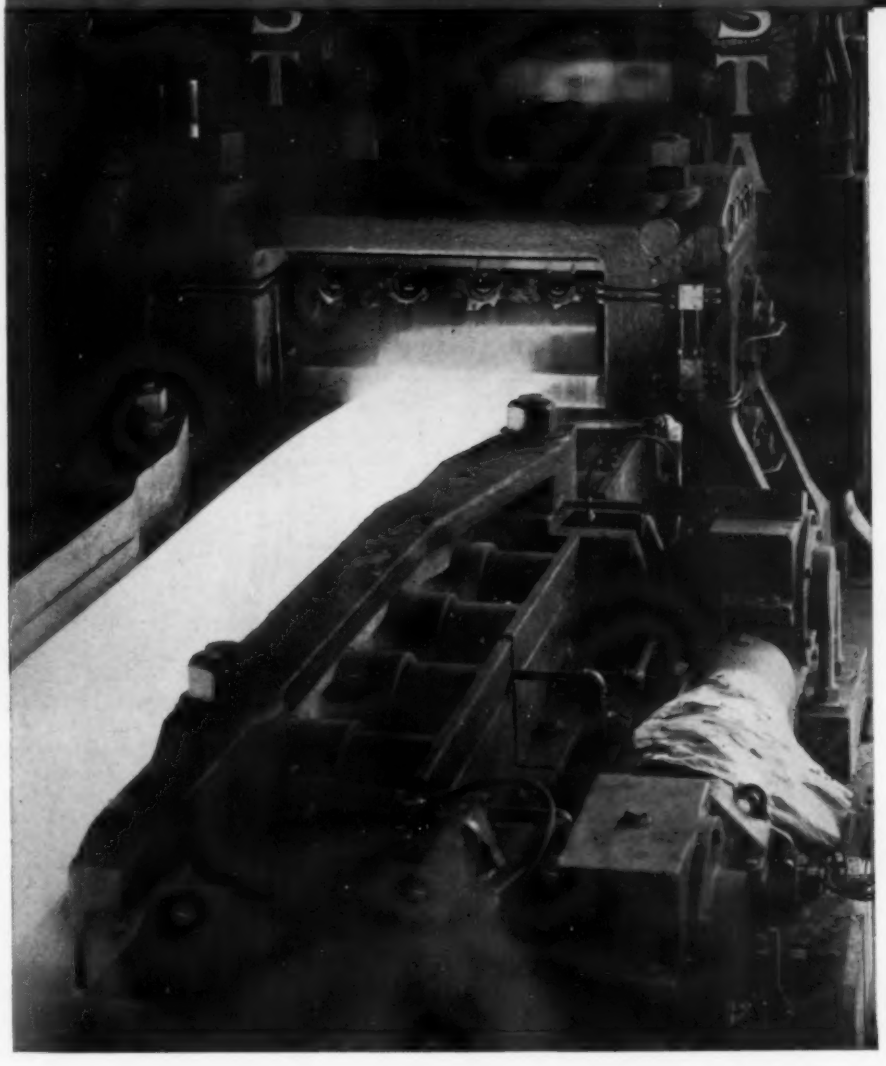
Roll inspection is as thorough and painstaking as every other step in roll-making at The National Roll & Foundry Company. • The inspector knows his job; he knows the rigid requiriments that every National roll must meet. • Such careful attention to details results in top quality and top performance in every National roll. Just try them and see.

National Rolls

THE NATIONAL ROLL & FOUNDRY CO.
AVONMORE, PENNSYLVANIA

SPECIALISTS IN IRON, ALLOY IRON AND STEEL ROLLS AND CASTINGS, STEEL ARMOR CASTINGS

SAVE A MILL A POUND... EARN AN EXTRA $2 A TON



A saving of only a mill per pound on the cost of rolling steel, adds up to an extra profit of $2.00 per ton. One way you can make this saving is to see that your equipment runs without unnecessary interruptions or slowdowns. And here Texaco can help you greatly.

First of all, Texaco has *a complete line* of steel mill lubricants . . . designed to assure you smooth, uninterrupted operation . . . longer life for all your machinery and equipment . . . lower maintenance costs.

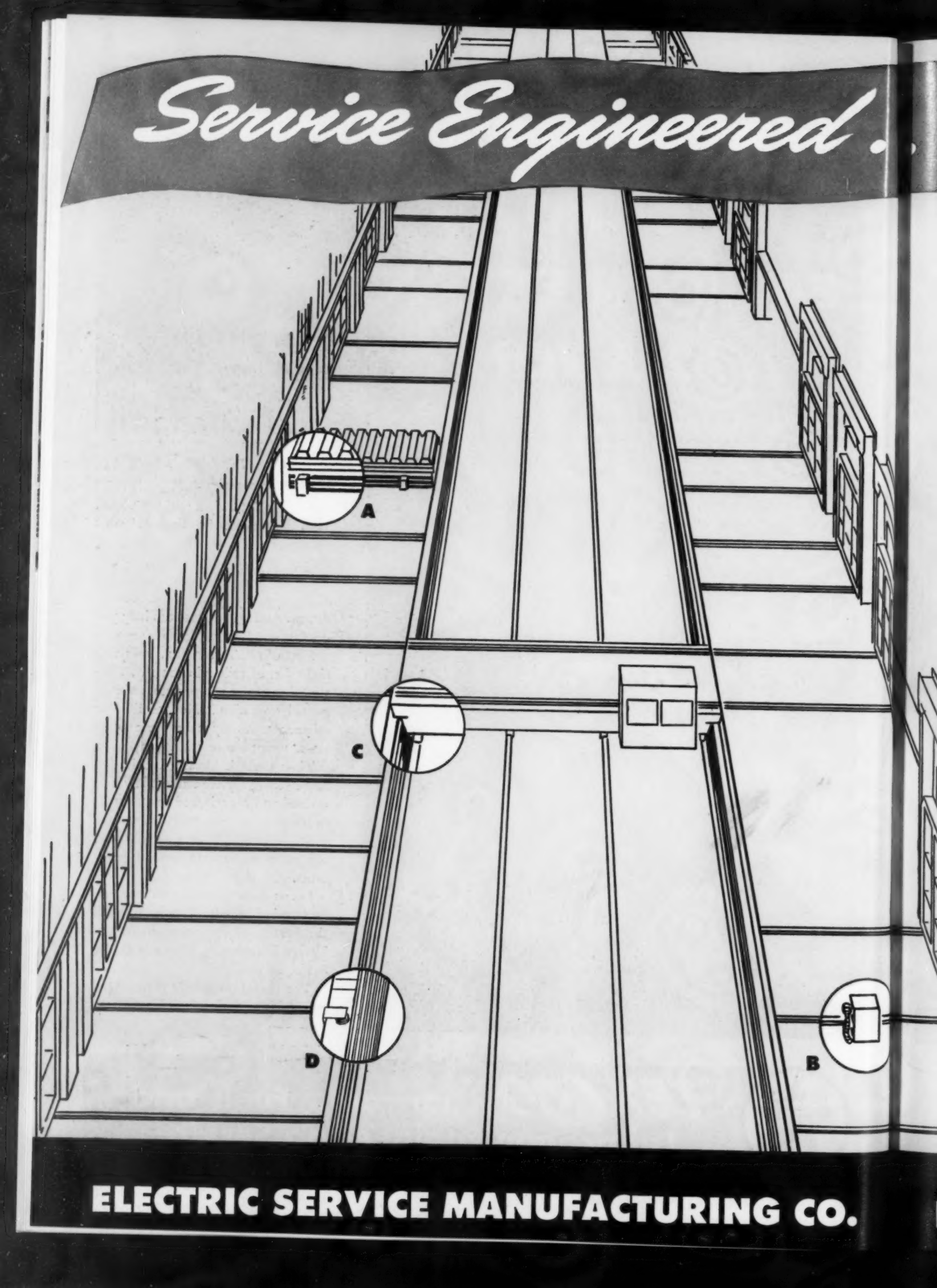
Then there is Texaco Lubrication Engineering Service rendered by men trained and experienced in steel mill operations . . . men qualified to help you in many cost-saving ways beyond the mere recommendation of lubricants.

Let us show you how you'll benefit by teaming up with Texaco. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Lubricants, Fuels and Lubrication Engineering Service


Service Engineered . . .
A
C
D
B
ELECTRIC SERVICE MANUFACTURING CO.

ELECTRIC SERVICE EQUIPMENT

IS BUILT TO MEET RUGGED SERVICE DEMANDS

Rugged service is routine in this huge installation in the Armorcast Plant of the Birdsboro Steel Foundry and Machine Company. Electric Service collector and insulation equipment was specified throughout by Gilbert Associates, because it is "service-engineered" to provide continuous trouble-free performance under severe operating conditions.

Here, in a battery of heat treating furnaces, heavy cumbersome tank hulls are conveyed on refractory-bed furnace cars. Rails fastened to the movable furnace cars are energized by the stationary Keystone Type LMI Collectors in the column.

All work movement is controlled through the pit transfer car. Individual furnace service lines are energized only when this pit transfer car is correctly aligned to pick up or deliver a furnace car at a particular furnace.

Whatever your plans, heavy-duty or ordinary industrial service, just call or write our service-engineering department. There is no obligation . . . their service is yours for better power transmission.

A FURNACE CAR Rail assembly is mounted on furnace car bed, using split porcelain Keystone Under-Contact Rail Insulators.

B COLLECTOR COLUMN Each furnace bay is equipped with three service columns. Collectors are Keystone Type LMI. Insulators are Keystone Glastic.

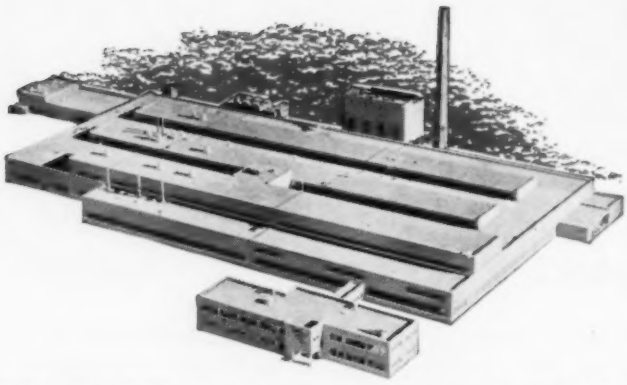
C PIT TRANSFER CAR This prime mover is equipped with the efficient, Type L Collectors on a seven rail contact assembly.

D PIT RAIL ASSEMBLY Flat rails and Keystone Glastic Insulators require minimum vertical space. Upper rails are plywood protected. Rails on opposite side energize furnace cars.

Write for detailed catalogs.

Philadelphia 32, Pa.

Represented in Canada by Lyman Tube and Bearings, Ltd., Montreal and Toronto



N-B-M Meadville . . . where the welcome mat is out. We're proud of this plant—its equipment and the skilled people who work in it. Proud enough, in fact, to offer a standing invitation to Blast Furnace Superintendents or other steel mill officials to visit us. When can *you* make an inspection trip?

These CASTINGS have "RUN THE GAUNTLET"

Here's where you'll find copper castings that have been subjected to rigid tests for soundness and quality.

Another Reason why N-B-M Meadville is a name to remember when you specify copper castings. What does your eye tell you when you see this picture? Chances are, "a big selection of copper castings". And, it's true that this big selection is typical of the wide range of copper castings that N-B-M Meadville is equipped to produce.

But, there's something more important that no ordinary photograph can show . . . because each of these castings has its own "success story". Each has been subjected to the most painstaking system of production and quality control that you'll find in any foundry . . . anywhere. That's why we say that castings reaching our shipping room have "run the gauntlet" . . . *we know they're right.*

From the molding floor to the shipping room, N-B-M Meadville accomplishes what should be, and is, the main objective of this modern, well-manned plant . . . ***what you specify . . . we ship.***

AMERICAN **Brake Shoe** COMPANY

NATIONAL BEARING DIVISION

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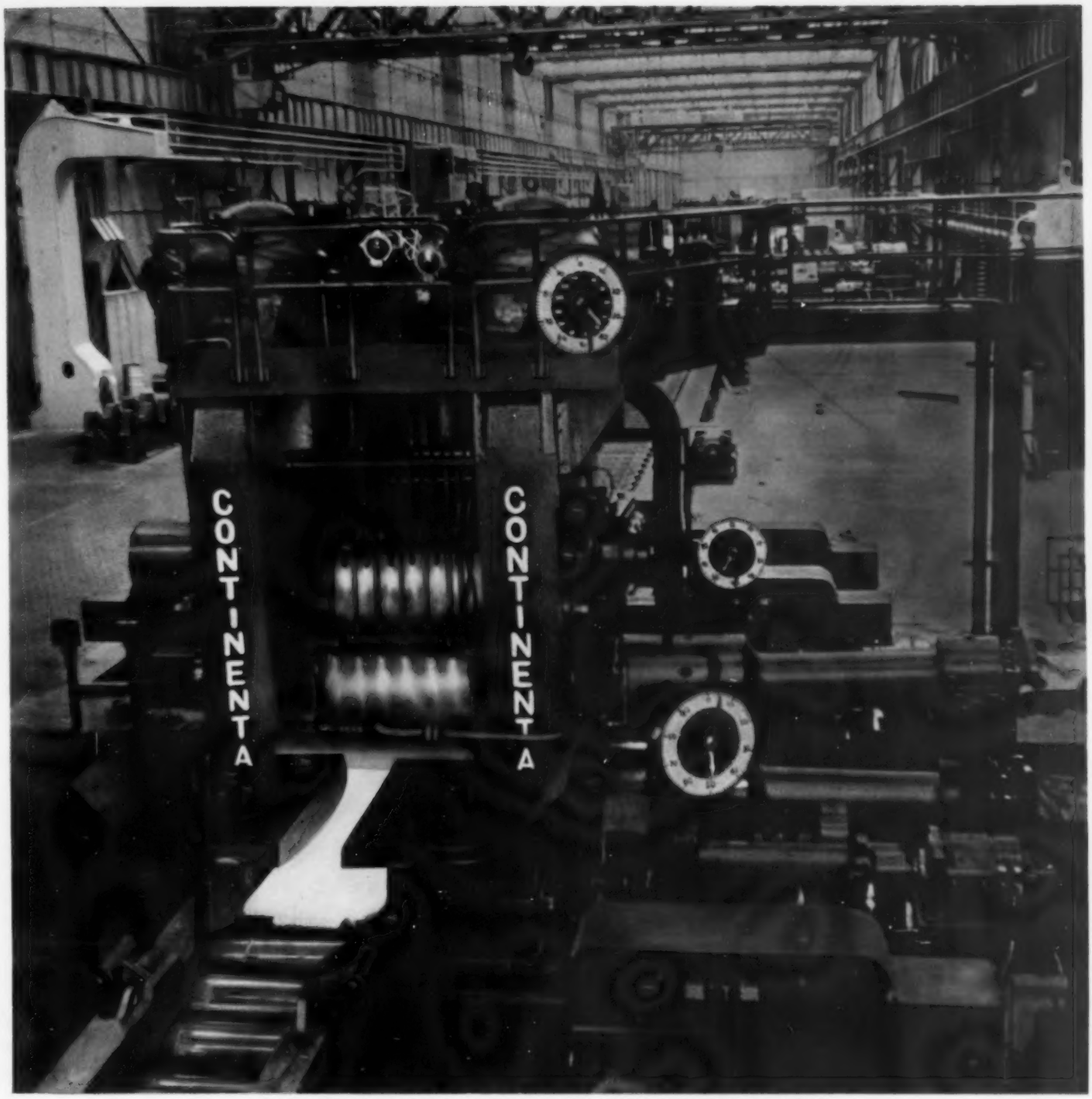


FOUR-HIGH REVERSING HOT MILL WITH VERTICAL EDGER

Complete Rolling Mill Installations

SLABBING MILLS
UNIVERSAL MILLS
PLATE MILLS
HOT STRIP MILLS
COLD STRIP MILLS
TEMPER MILLS

Mills complete with Auxiliary Equipment

★ ★ ★

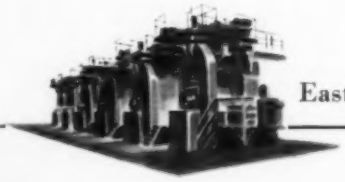
CONTINENTAL CHIPPER
ROLL LATHES
SPECIAL MACHINERY

BLOOMING MILLS
STRUCTURAL MILLS
RAIL MILLS
BILLET MILLS
ROD MILLS
MERCHANT MILLS

CASTINGS—carbon and alloy steel from 20 to 250,000 pounds

ROLLS—iron, alloy iron and steel rolls for all types of rolling mills

WELDMENTS—fabricated steel plate, or cast-weld design.



Plants at
East Chicago, Ind. • Wheeling, W. Va. • Pittsburgh, Pa.

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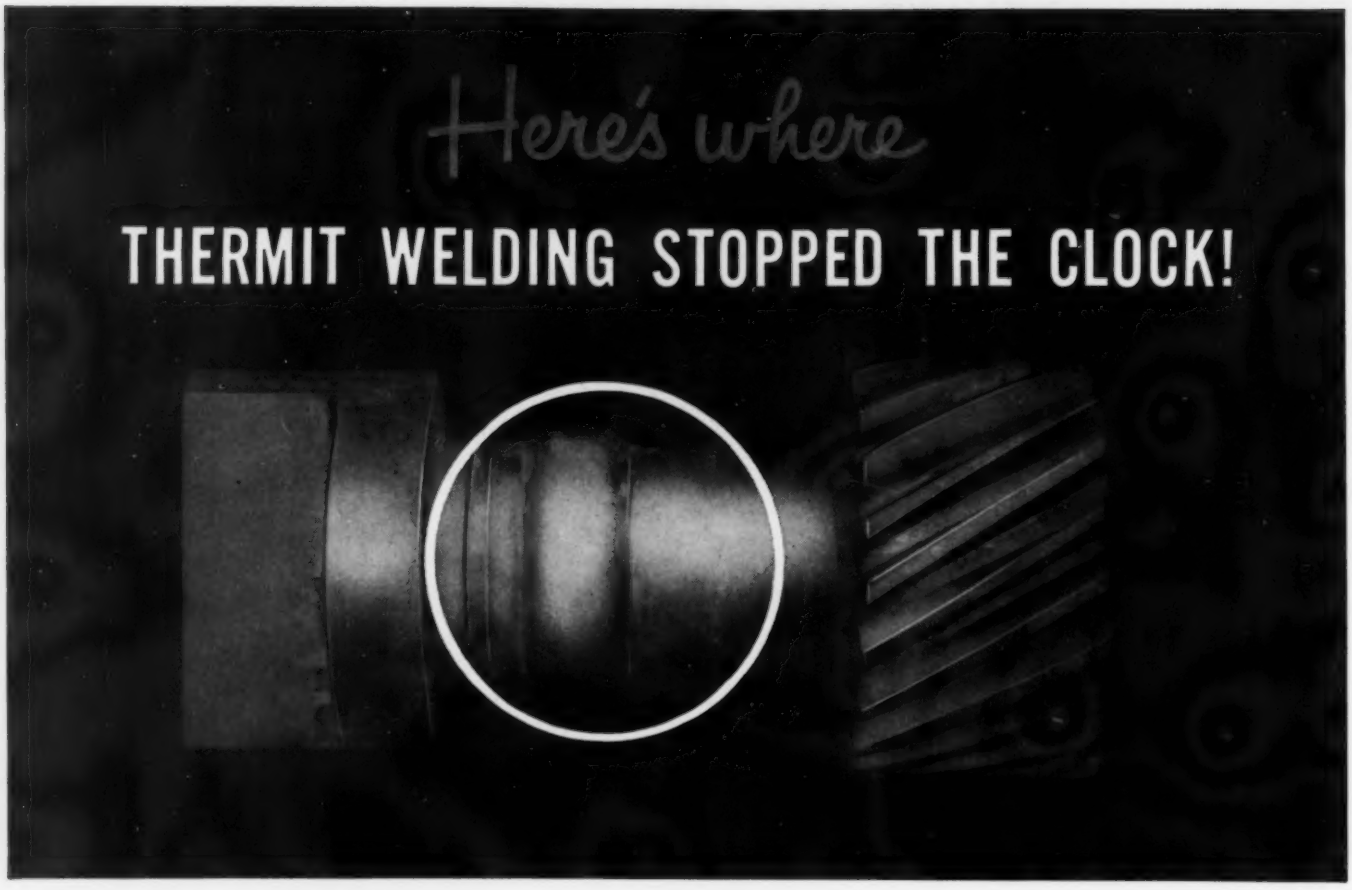
CONTINENTAL
Foundry & Machine
Company

Here's where

THERMIT WELDING STOPPED THE CLOCK!



Weeks of idle time saved in returning pinion to duty...

When a piece of vital equipment breaks down, Thermit Welding stops the clock on idle time — enables quick, economical repairs on a variety of parts. Only a *minimum* of technical skill is required.

See the time-saving repair made on the 48" mill pinion shown above. The 28" neck was Thermit welded — and the pinion was back in operation *weeks* before a replacement could be obtained.

WAITING FOR REPLACEMENT PARTS COSTS TIME AND MONEY!

USE THERMIT WELDING

ALWAYS READY TO WORK FOR YOU

METAL & THERMIT CORPORATION

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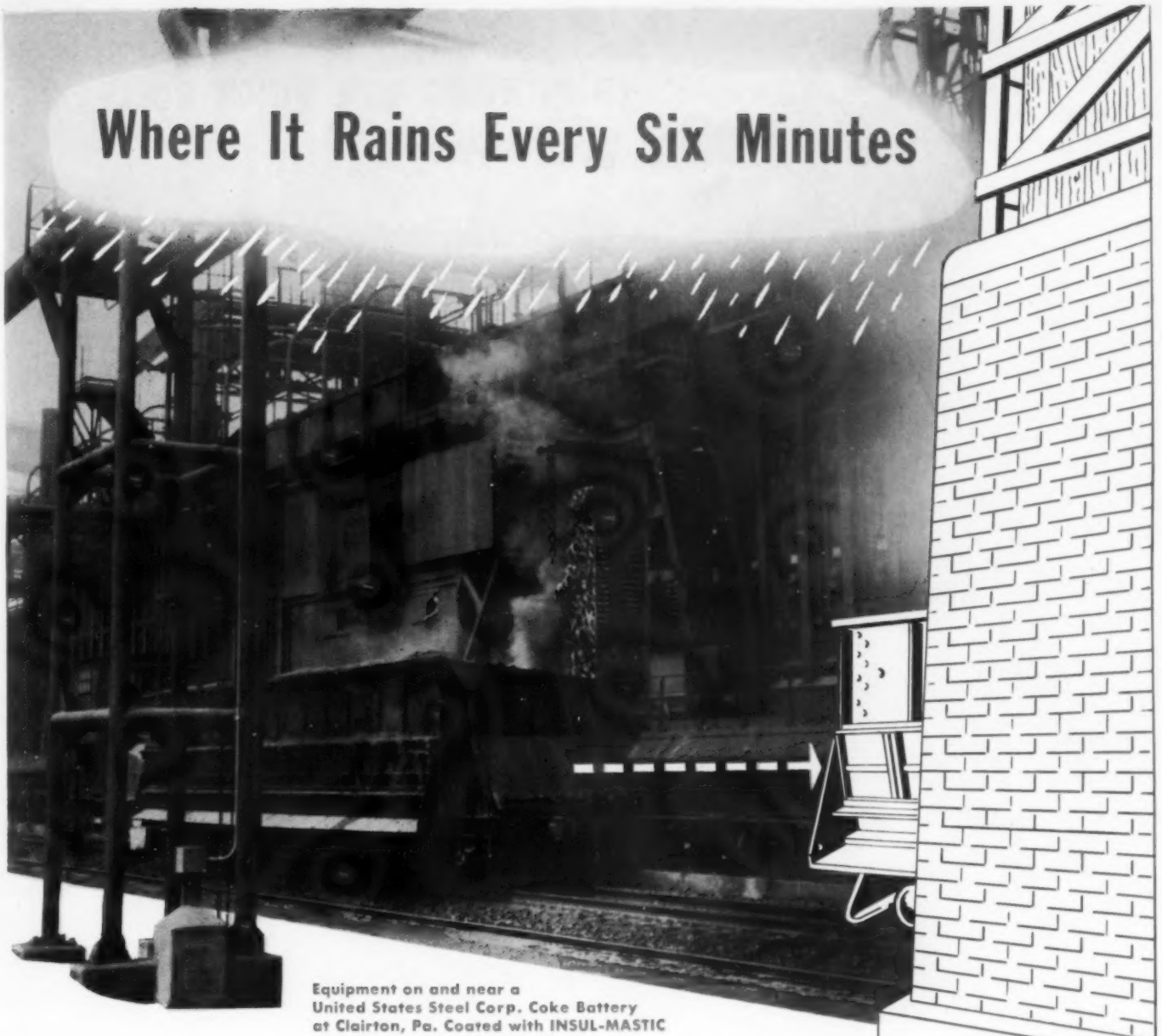
Where It Rains Every Six Minutes



Equipment on and near a
United States Steel Corp. Coke Battery
at Clairton, Pa. Coated with INSUL-MASTIC

Every six minutes in a Coke By-Products Plant a carload of burning coke is quenched in a deluge of water. The clouds of steam that rise from the car drop acid-laden rain on all nearby equipment. Corrosion was severe until steel mills and chemical companies began to coat their metal equipment with INSUL-MASTIC. Now, some of these companies can show you applications several years old that have saved thousands of dollars in maintenance and new equipment expense.

Acids, alkalis, rain and sun will not appreciably shorten the life of the heavy INSUL-MASTIC Bituminous Coatings. Years after they have paid for themselves they will still prevent corrosion. They also Vaporseal Insulation, Waterproof and Insulate.

For a neat looking plant, resurface old masonry buildings with INSUL-MASTIC and Colored Stone Granules.

Write today for the book, "INSUL-MASTIC IN INDUSTRY".

Think First of the Coatings that Last!

Insul-Mastic

CORPORATION OF AMERICA
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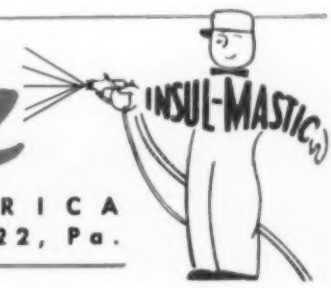


THE *New Look* IN PICKLING LINE PINCH ROLLS

Youngstown Continuous Strip Pickling Line Complete with Latest Operating Features.

PARALLOY

REGISTERED TRADE-MARK

Eliminate

Pick up
Scratching
Galling
Chatter Marks

the rolls with uniform hardness all through, which insures maximum tonnage from new to scrap diameter.

Pickle more tons between grinds with Paralloy rolls . . . Increase production and cut maintenance costs. Let our engineers quote on Paralloy pinch rolls—modernizing your present pickling line—or on a complete new pickling line.

The Youngstown Foundry & Machine Co.

OVER SIXTY YEARS OF SERVICE TO THE STEEL INDUSTRY

Youngstown, Ohio

13

your best buy in magnets

55-inch EC&M Magnet loading charging bucket

Month in and month out, EC&M Type SW ALL-WELDED Lifting Magnets give evidence of speedy handling of pig and scrap iron. *Costs are lower because output is higher.*

Equally important is the fast release of the load at the point of discharge. EC&M Automatic-Discharge Magnet Controllers are adjustable to suit material handled and size of magnet; adjustment permits compensation for voltage variation. *This exclusive EC&M feature cuts down the time between magnet-trips.*

For topmost performance, specify EC&M Lifting Magnets. *The high return quickly repays the low initial cost.*

advantages of ALL-WELDED magnets

1. Sealed against entrance of moisture.
2. No pole-shoe tightening maintenance.
3. Better proportion of coil space.
4. High lifting capacity throughout magnet life.

write for bulletin **900**

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

1878 75 1953
YEARS OF ELECTRICAL PROGRESS

ONE OF FIVE 2000-HP G-E SYNCHRONOUS MOTORS USED FOR AIR-COMPRESSOR DRIVES AT FORD MOTOR CO., ROUGE PLANT.

FOUR REASONS WHY G-E SYNCHRONOUS MOTORS

1. STRONG, FABRICATED FRAMES . . .

The welded steel-plate stator frame provides maximum rigidity in a comparatively lightweight construction. The sturdy channel-shaped frame consists of a wrapper plate firmly secured by continuous welds to rigid side plates. This design, proved by years of operating experience, affords more than ample strength for clamping and supporting the stator core.

2. G-E BRUSHES ON G-E MOTORS . . .

Brushes on G-E synchronous motors are a product of G-E teamwork. Close co-operation between machine designers and laboratory engineers means you get the right brush on the right motor for your particular application. In addition to extensive research and testing, all new and improved grades of brushes are thoroughly field-tested before approved for standard use.

Dependable G-E Synchronous Motors on 24-Hour Assembly-line Service

Ford Motor Company uses G-E synchronous motors for air-compressor drives

Compressor-motor dependability is really put to test on 'round-the-clock service at Ford Motor Company's Rouge plant. Compressed air is used 24 hours a day on many assembly operations, and a dependable supply is vital to keep production lines moving.

To furnish this all-important air, five 2000-hp G-E synchronous motors drive reciprocating compressors continuously—with only slight reductions in demand on certain shifts.

G-E synchronous motors can be relied upon for such continuous service with minimum downtime. You can depend on them because in back of every G-E synchronous motor stand more than half a century of motor engineering leadership . . . superior research and testing facilities to assure excellent component materials . . . and a corps of experienced craftsmen who are proud of the equipment they build—and build it to last.

The next time you consider a drive for heavy, continuous-service equipment be sure to call in your G-E representative to discuss any special application problem you may have. Have him explain the many money-saving uses for G-E synchronous motors and point out their operating economies.

In the meantime, you can obtain more information on G-E synchronous motors by writing for these publications: GEA-5332, "Low-speed Synchronous Motors," or GEA-5426, "High-speed Synchronous Motors." Write to Section 770-29, General Electric Co., Schenectady 5, N. Y.

You can put your confidence in—

GENERAL ELECTRIC

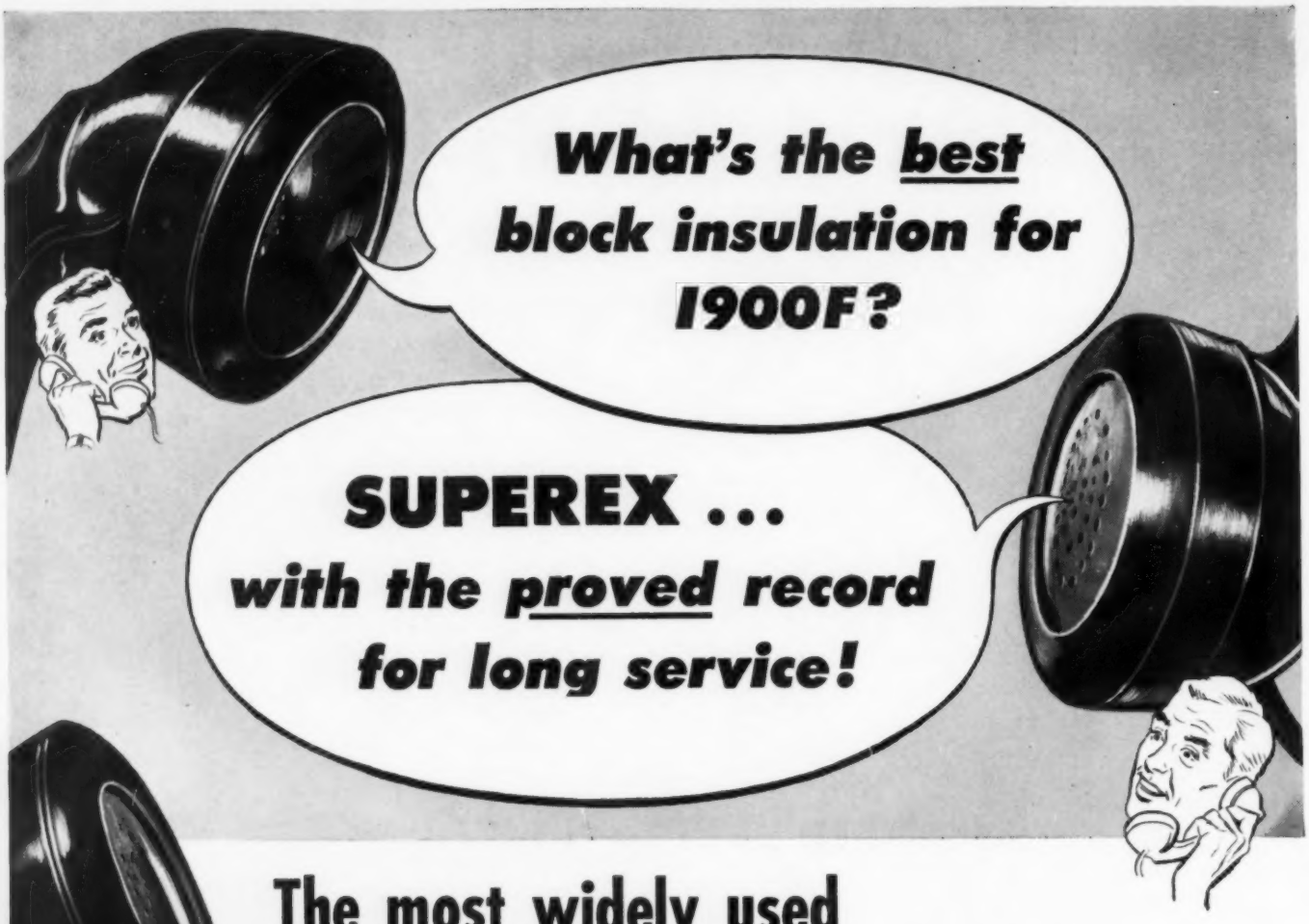
GIVE LONG, DEPENDABLE SERVICE . . .

3. LONG INSULATION LIFE . . .

Insulating materials, manufactured in our own factories by the most modern methods, conform to rigid G-E specifications and are applied by experienced operators, above. Thus coils are uniform, interchangeable, mechanically rugged, and moisture resisting.

4. LOW-RESISTANCE CONNECTIONS . . .

For dependable operation, stator windings are silver brazed, as shown above. Joints of this type have low electrical resistance, exceptional thermal and mechanical strength. These important properties are difficult to obtain by other methods.



The most widely used high temperature block insulation for over a quarter century...

SUPEREX® high temperature block insulation has long been industry's No. 1 choice for service temperatures up to 1900F. It provides *major* economies . . . reduces fuel costs, cuts heat losses, keeps maintenance expense down, costs less to install and has long service life.

These are the reasons why 90% of the nation's hot blast stoves are Superex insulated . . . and why the low cost open hearth steel producers use Superex in their regenerators.

Made of specially selected and calcined diatomaceous silica blended with other insulating materials and bonded with asbestos fiber, Superex will safely withstand temperatures up to 1900F with negligible shrinkage.

Superex has been used with outstanding success in all types of industrial and metallurgical furnaces and ovens, stationary and marine boilers, auxiliary power plant equipment, regenerators, kilns, roasters, high temperature mains, flues and stacks.

Superex has all these important advantages...

Low thermal conductivity—Exceptionally high heat resistance (1900F) combined with excellent insulating value.

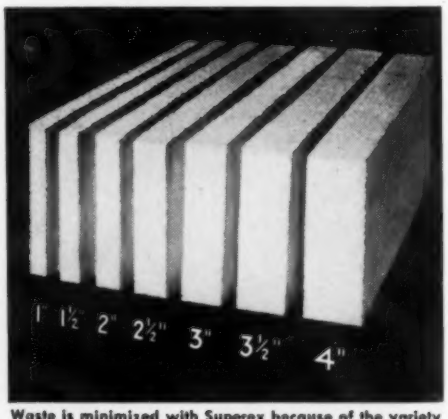
Light weight—Approximately 2 lb per sq ft per in thickness.

Great physical strength—Approximately 6 tons pressure per sq ft are required to compress Superex ⅛ in.

Long, efficient service life—Superex maintains high insulating value indefinitely—will not disintegrate in the service for which it is recommended.

Fast, easy application—Superex may be cut with an ordinary knife or saw for fitting around openings or to irregular surfaces. Because of its light weight and convenient sizes, Superex assures fast and economical installations.

For complete information about Superex block insulation, write for Brochure IN-134A. Address Johns-Manville, Box 60, New York 16, N. Y. In Canada, write 199 Bay Street, Toronto 1, Ontario.



Waste is minimized with Superex because of the variety of thicknesses available. Special shapes and intermediate thicknesses between those shown are also available.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville *first in* **INSULATIONS**

Gives white hot steel the "kid glove" treatment

GIGANTIC MACHINES with thousands of moving parts are used to shape white hot ingots into plates and sheets. All of these hard-working machine parts are subject to intense heat . . . normal in steel manufacturing. Because of the intense heat, lubrication is a serious problem.

U. S. Steel has tried various types of greases in order to eliminate the problem of oil burn-out. Now they're using a product of Shell Research, Shell Alvania Grease. Result: better lubricating action *at once*. Months after the original installations, rollers were removed and an excellent film of grease was still present.

At the other extreme, zero weather caused grease in an automatic lubricating system to congeal and become unpumpable. Shell Alvania was tried and clogging promptly stopped. This multi-purpose grease is now used extensively in low-temperature operations at U. S. Steel's Ohio Plant.

SHELL ALVANIA GREASE

- **resists oxidation**
- **will not squeeze out**
- **extends periods between overhauls**
- **provides exceptional lubrication in high or low operating temperatures.**

Shell Alvania Grease can cut down costly maintenance and save time and money in *your* plant. Write for technical information.

SHELL OIL COMPANY

50 WEST 50TH STREET
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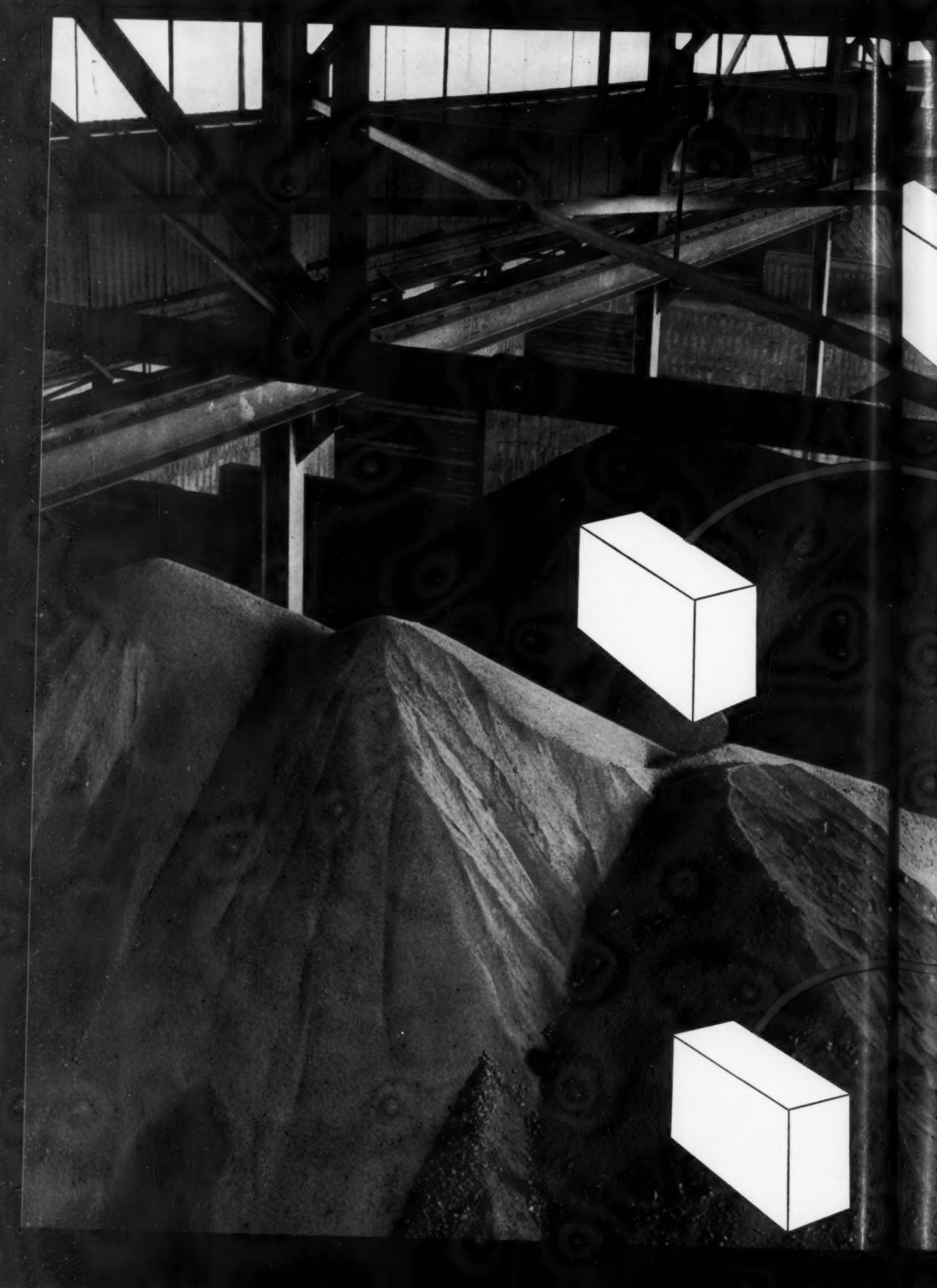
100 BUSH STREET
SAN FRANCISCO 6, CALIFORNIA

SHELL



MOUNTAINS OF MAGNESITE

● From the hills of the west in Washington State, and the sea-water off the shores of New Jersey, comes magnesite, an essential raw material for many refractories.

These storage piles of magnesite grains at GREFCO's Baltimore Works await processing to become part of the manifold basic refractory products urgently required by America's metallurgical and other industries.

RITEX . . . STEELKLAD . . . most GREFCO burned basic brick . . . all contain substantial amounts of magnesite which gives them high refractoriness and slag resistance necessary for their use in open hearth furnace bottoms . . . front and back walls . . . end structures . . . roofs . . . in open hearth mixers and in their many other applications in the steel industry.

When the nation prospers and steel is on the move, you can see these mountains of magnesite dwindle and be replenished. At such times, for magnesite and all other refractories, GREFCO offers its far-flung facilities for raw materials production, its many manufacturing plants, and its hundreds of distributing agencies to insure a steady flow of dependable high quality refractories for all industry. If you have a furnace of any kind, call on GREFCO for a truly *complete refractories service.*

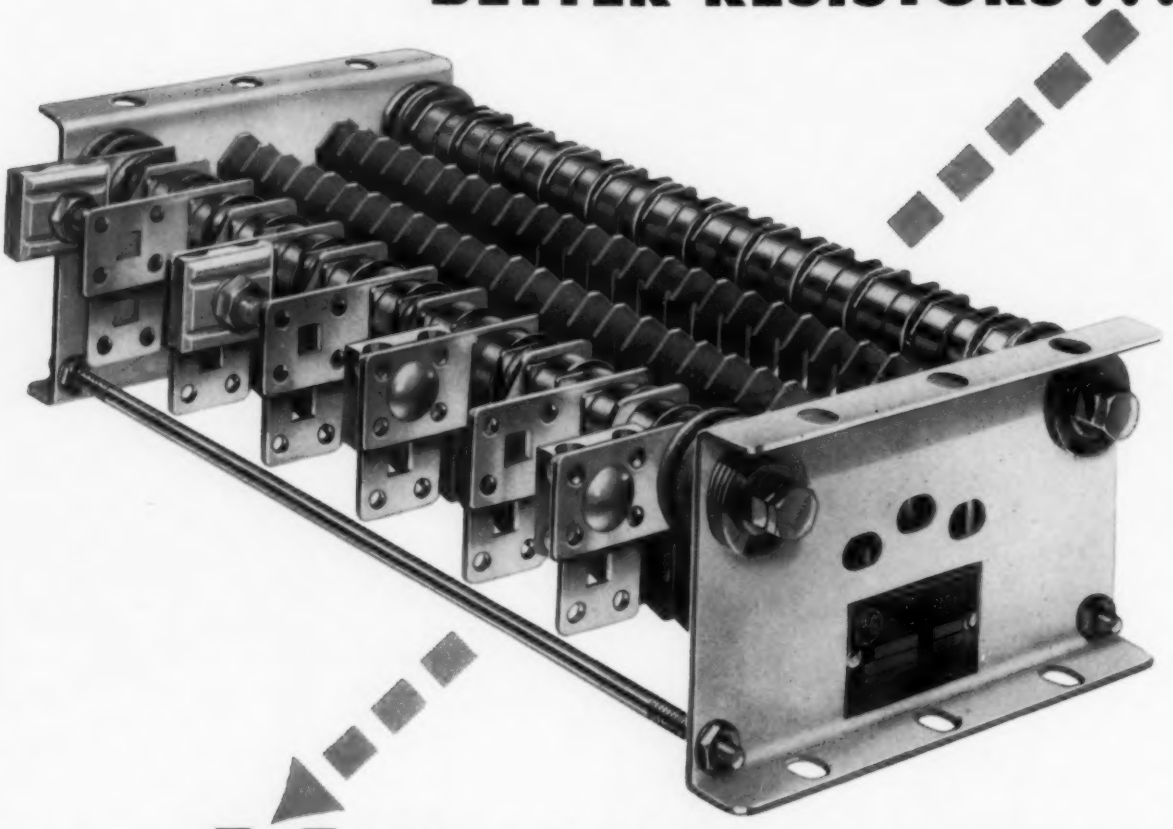
In Baltimore GREFCO maintains the world's most complete refractories research laboratories for experimental operations, and to analyze and control the high quality of its regular production.

When you count on GREFCO, you can be sure—because we make *sure!*

GENERAL REFRACTORIES COMPANY
PHILADELPHIA

SEVERE MILL SERVICE *Demands*

BETTER RESISTORS...



P-G *Steel Grid Resistors* MEET EVERY REQUIREMENT FOR LONGER RESISTOR LIFE...

NON-BREAKABLE • ALL STEEL CONSTRUCTION • MICA INSULATION • CORROSION RESISTANT • UNAFFECTED BY VIBRATION OR MOISTURE • PROVISION FOR EXPANSION • ADEQUATE VENTILATION • RUGGED TERMINALS

These features, plus accurate resistance values and ample capacity ratings, make P-G the *better resistor,* capable of solving your resistor problems. Specify P-G for your next application, especially, if your operating conditions are *severe.*

Write for Bulletin No. 500

P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI 2, OHIO

An Orchid to a Champion

45" Reversing Slabbing Mill which has broken all world records by rolling 214,842 net slab tons in one month.

designed and built by

United

ENGINEERING AND FOUNDRY COMPANY

Pittsburgh, Pennsylvania

PLANTS AT PITTSBURGH • VANDERGRIFT • NEW CASTLE
YOUNGSTOWN • CANTON

SUBSIDIARIES: ADAMSON UNITED COMPANY, AKRON, OHIO
LOBDELL UNITED COMPANY, WILMINGTON, DELAWARE
STEDMAN FOUNDRY AND MACHINE CO., INC., AURORA, INDIANA

Designers and Builders of Ferrous and Non-Ferrous Rolling Mills, Mill Rolls, Auxiliary Mill and Processing Equipment, Presses and other heavy machinery. Manufacturers of Iron, Nodular Iron and Steel Castings and Weldments.

NORTH..SOUTH..EAST..WEST..EVERYWHERE!

P&H

STEEL MEN PREFER
MILL TYPE CRANES
for longer, finer service

Now, the number is well over the 2000 mark — more and more P&H Cranes serving the steel industry. There's good reason for the preference steel men put in P&H . . . and that is *performance*. It's measured in longer years of service, in lower costs, in more dependable operations. Learn more about P&H Mill Type Cranes. Write for your copy of Bulletin C-42.

P&H ***...ahead in added values***

3-Gear Case Bridge Drive — for perfectly equalized motive power.

No Open Gears at Trucks — gear reductions are fully enclosed, running in oil.

Flexible Couplings at Wheel Shafts — for smoother starts, longer bearing life.

Split Gear Cases — easier inspection and maintenance.

Large Diameter Cross Shaft — greater strength, lower torque to minimize strain.

Hoist Sheaves — readily accessible from trolley deck. All hoist gears, including drum gear and pinion, run in oil.

P&H Motors, brakes and controls available.

P&H **OVERHEAD CRANE DIVISION**

HARNISCHFEGER
CORPORATION

Milwaukee 46, Wisconsin

POWER SHOVELS • CRAWLER AND TRUCK CRANES • OVERHEAD CRANES • HOISTS • ARC WELDERS AND ELECTRODES • SOIL STABILIZERS • DIESEL ENGINES • PRE-FAB HOMES

the practical answer to your rust problems indoors and out . . . . . so easy to use that one man often does the work of two.

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STOPS RUST!

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Rust-Oleum *cuts costly manhours!* Just scrape and wirebrush to remove rust scale and loose rust . . . then brush Rust-Oleum 769 Damp-Proof Red Primer *directly over the sound rusted surface.* Rust-Oleum finish coatings available in many colors, aluminum, and white give you *double protection.* Sandblasting and other costly preparations are *not* usually required. Specify Rust-Oleum . . . prompt delivery from Industrial Distributor stocks in principal cities.

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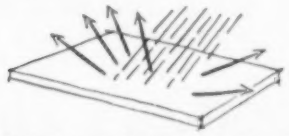
FREE SURVEY: Ask a Rust-Oleum specialist to conduct a survey including actual applications, tests, and recommendations. No cost or obligation. See Sweets for nearest Rust-Oleum distributor or write for literature today.

FACTS

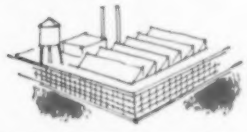
prove the economy of Rust-Oleum

Apply Directly Over Sound Rusted Surfaces—Brush Rust-Oleum 769 Damp-Proof Red Primer *directly* over *sound rusted surface* after scraping and wirebrushing to remove rust scale and loose rust. Sand-blasting, chemical pre-cleaning and other costly preparation methods are *not* usually required.

Available In Many Colors, Aluminum, and White, Brush, Dip, or Spray—Get *double protection.* Beautify as you protect with Rust-Oleum finish coats in the color of your choice.



Practical, Economical Answer To Your Rust Problem—Rust-Oleum resists rain, heat, fumes, sun, salt air, salt spray, and many chemicals—as well as condensation indoors.



Proved Throughout Industry For Over 25 Years—On tanks, girders, pipes, machinery, roofs, buildings, fences, stacks, throughout industry — Rust-Oleum has *proved* its capacity to stop rust for over *25 years.*

There is Only One Rust-Oleum

Distinctive as your fingerprint, Rust-Oleum is an *exclusive formula* developed by a Master Mariner during more than 20 years battling actual rust conditions at sea. It incorporates a *specially-processed* fish oil vehicle that will *dry,* is *odor-free,* and is formulated in *many colors.* Be sure you specify genuine Rust-Oleum to assure satisfaction. Accept no substitute.

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make mighty expensive

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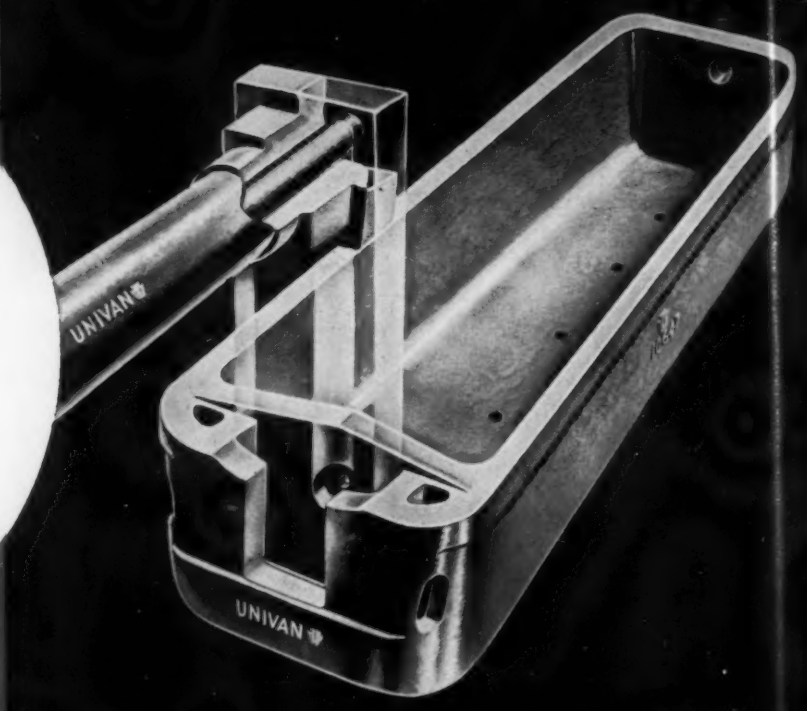

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Here's why . . . All square corners have been replaced by round ones, insuring a sound casting . . . The specially designed, reinforced head means "double life" without cracking or distortion even with today's higher temperatures . . . Union Boxes are cast from UNIVAN—a special nickel vanadium steel that holds its superior strength under extreme conditions of heat, cold and shock.

Whether you operate with 20, 25, 36 or even 50 cu. ft. capacity charging boxes, we welcome the opportunity to prove that you can do a faster charging job for a longer time at less cost with Union Double Life Head Charging Boxes.

BLAW-KNOX COMPANY
UNION STEEL CASTINGS DIVISION
PITTSBURGH 22
PENNSYLVANIA

BLAW-KNOX

By MELVIN NORD, Patent Attorney, Detroit, Mich.

Patent Reviews

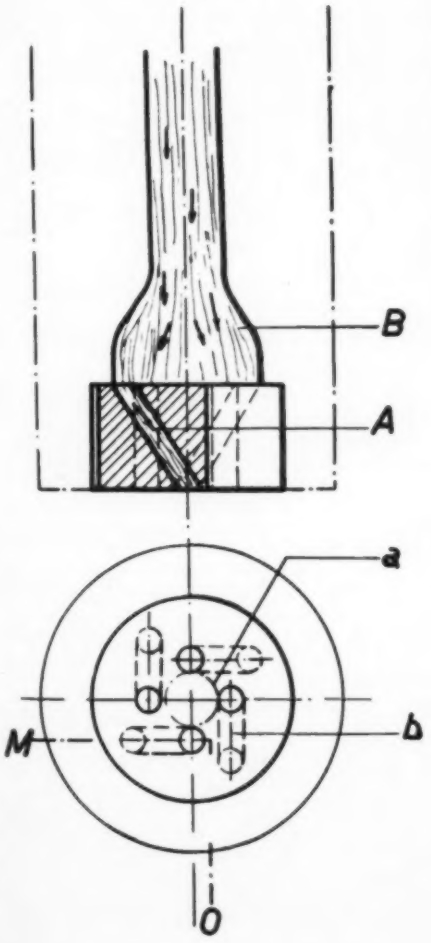
. . . . copies of patents may be obtained from the Commissioner of Patents, Washington 25, D. C., at 25 cents each . . . . patents reviewed cover period June 16 through July 7, 1953 . . . . .

REFINING STEEL WITH PURE OXYGEN

▲ The use of pure oxygen in the refining of steel has been known since the introduction of the bessemer process. The reasons why oxygen has not been more widely used are: (1) the high production costs of oxygen, which until recently made its use impracticable for the refining of steel; and (2) the inadequacy of available methods for introducing the oxygen into the melt. Thus, attempts to use oxygen in bottom-blow or side-blow converters failed because the tuyeres became choked, and water-cooled copper tuyeres had too short a life.

These disadvantages can be overcome if the oxygen is introduced into the bath from above. Experiments of this type have so far failed because slag prevents contact of the oxygen with the steel, even if supersonic gas jets are used. Even when the oxygen jet was directed obliquely, it proved impossible to free the surface of the steel, since the motion of the slag is such that it is continuously drawn to and over the point of contact.

Figure 1



In U.S. 2,644,746, issued July 7, 1953 to Hubert Hauttmann and assigned to Vereinigte Oesterreichische Eisen-und-Stahlwerke Aktiengesellschaft, a method is disclosed for overcoming these obstacles. It is claimed that the area of contact of a vertically directed gas jet with the bare surface of a steel bath can be kept free from slag without using supersonic velocities, by giving a rotary motion to the gas jet by a suitably formed nozzle or tuyere. The rotating gas jet causes the slag cover at the point of impact to rotate similarly in front of the impact area. As soon as the metal surface has been laid bare, an exceedingly rapid reaction takes place between the oxygen and the metal of the bath, without the gas jet penetrating into the metal.

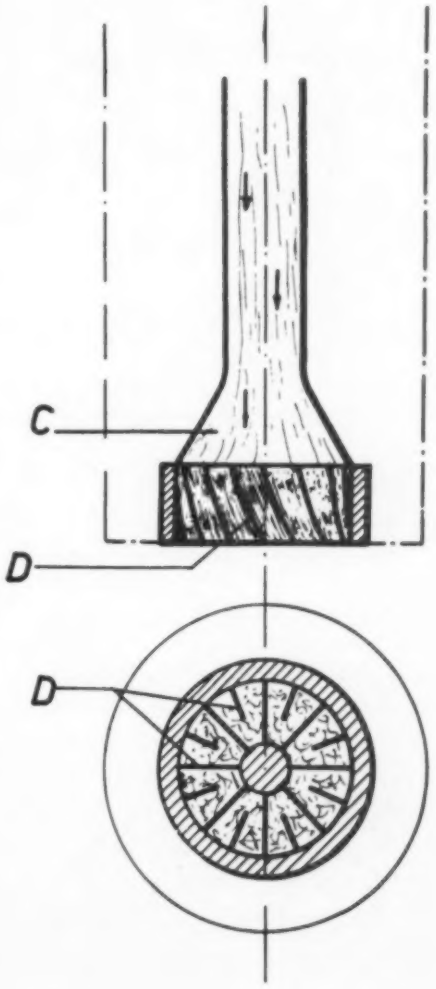
Two forms of nozzles are disclosed in the patent. Figure 1 shows one type of nozzle, and nozzle head.

In the second example, shown in Figure 2, the jet is caused to rotate by guide blades or vanes D provided at the mouth of the nozzle head C, the shape of the blades being such as to cause the issuing jet to rotate.

AIR-OPERATED APPARATUS FOR REMOVING DUST ACCUMULATIONS FROM REGENERATIVE CHECKERWORK

In U.S. 2,641,791, issued June 16, 1953 to Harold W. Wells, an air chest is lowered successively into the open spaces of the checkerwork, one after the other. As shown in Figure 3, an air supply pipe 11 extends upward from the chest 10, permitting the apparatus to be manipulated from the top of the checkerwork. Nozzles 13 communicating with the chest project radially in several directions from it, with downwardly projecting ports 14 and an outwardly opening port 15 at the end. Jets of air from the nozzles carry dislodged dust to the bottom of the checkerwork, from which it may be readily removed. A turbine 16 is suspended below the chest and receives air from it, the air being exhausted through opening 17. A shaft 18 extending downward from the tur-

Figure 2



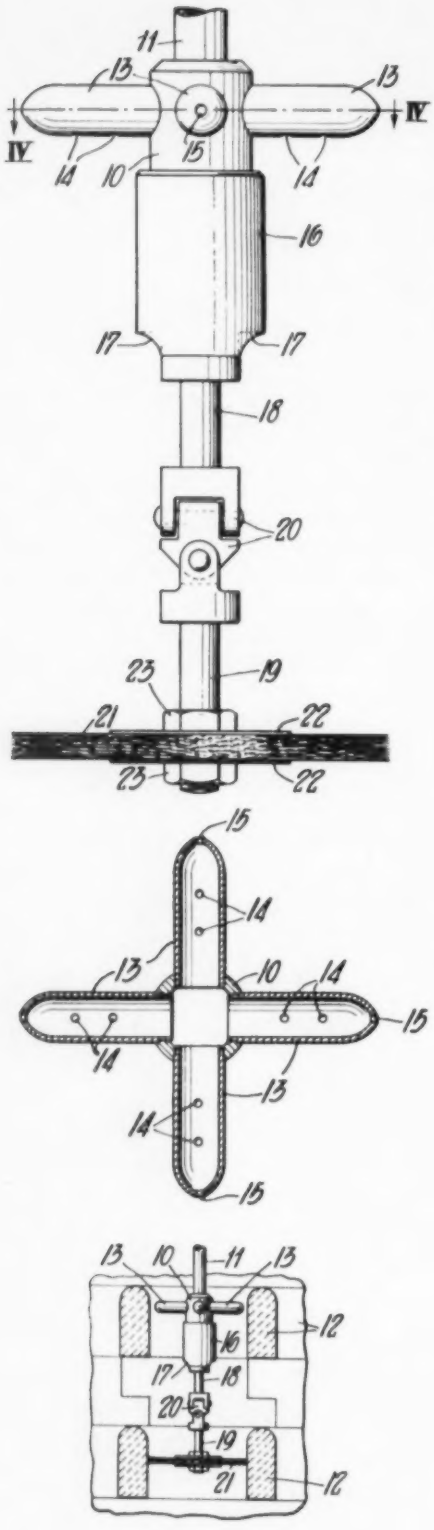


Figure 3

bine is provided with a circular wire brush 21 to dislodge accumulations of dust deposited on the bricks.

INGOT STRIPPER

U.S. 2,641,806, issued June 16, 1953 to Roy J. Leckrone, and assigned to Pittsburgh Engineering and Machine Co., provides a self-contained ingot stripping unit of light weight which may be suspended from the hook of a conventional traveling crane when in use and removed when not in use. The stripper employs a self-contained power unit which is remotely controlled from the crane cab. The stripper is lifted together with the mold and the ingot, and the ingot is then pushed down out of the mold while the mold is suspended. The stripper may then carry the empty mold to any desired location and deposit it.

CUPOLA MELTING OF CAST IRON

A small amount of calcium carbide is added to the cupola charge in U.S. 2,643,185, issued June 23, 1953 to Sam F. Carter, Jr., and assigned to American Cast Iron Pipe Co. Advantages claimed include improved desulfurization efficiency and greater carbon pick-up of the iron.

Lump calcium carbide (½-3in.) is mixed with the coke of the cupola charge, so that the carbide constitutes between 1 and 7 per cent by weight of the metal portion of the charge (normally about 3 per cent). Details of the method of charging, and a considerable amount of operating data are given in the patent specification. It is claimed, for example, that a sulfur content as low as 0.009 per cent has been produced in this way, and that as much as 0.187 per cent sulfur has been removed from an all scrap charge. Carbon pick-up sufficient to produce cast iron containing over 3.2 per cent carbon from all-steel charges is also claimed.

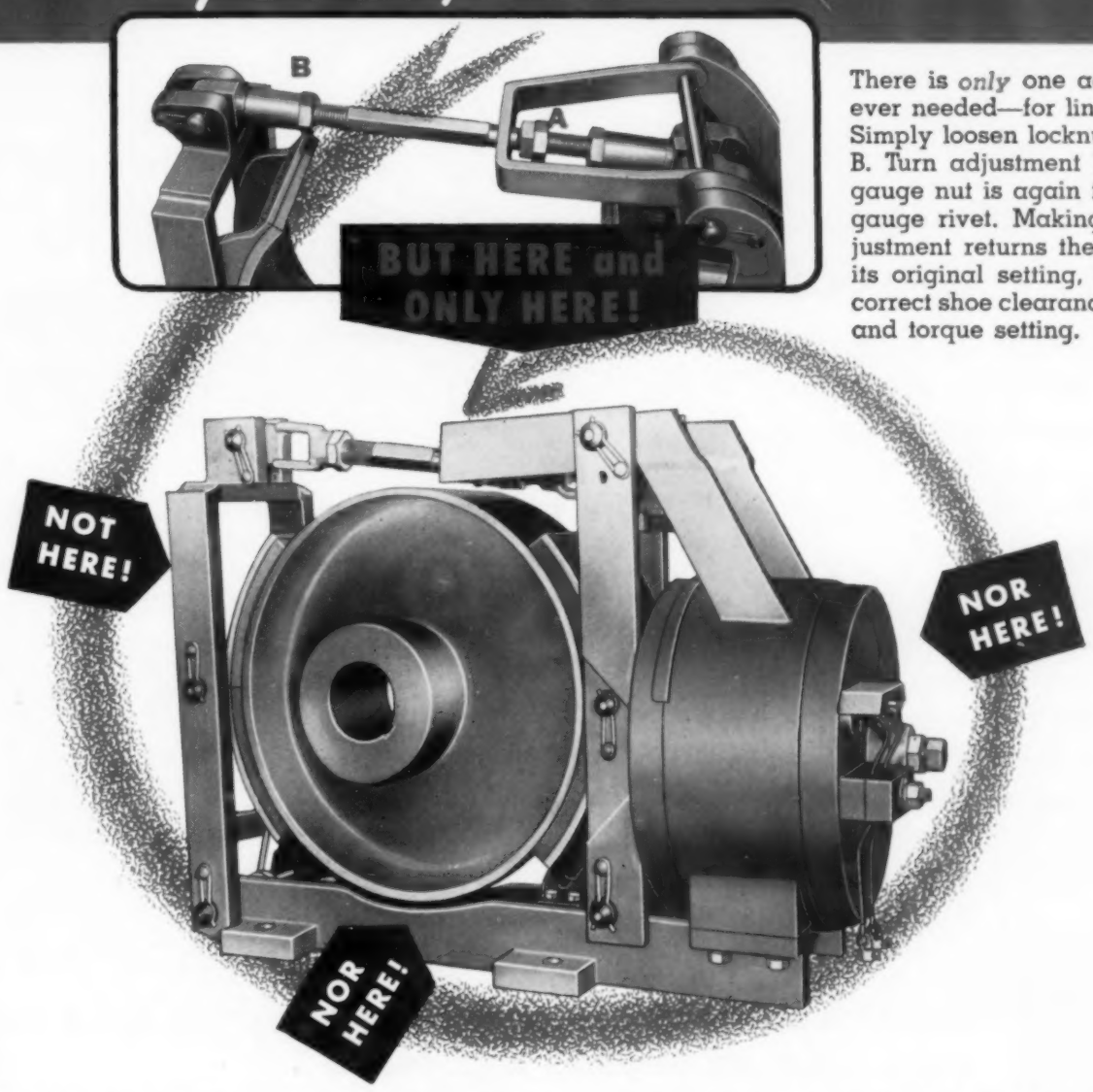
NITRIC ACID PICKLING

Nitric acid has some advantages over sulfuric acid in the pickling of steel, but its use has been limited, because it is expensive. In U.S. 2,643,-204, issued June 23, 1953 to Edgar B. Mancke and assigned to Bethlehem Steel Co., a method of regenerating the nitric acid in the spent pickling liquor is disclosed.

As an example of the method, hot rolled sheet or ordinary carbon steel, with scale on its surface, is pickled with an aqueous solution of nitric acid, having an acid content of 10 per cent, until the acid content is reduced to 5 per cent and the solution contains a substantial amount of ferric nitrate. This liquor is then heated to 400 F under pressure in an autoclave, which causes the precipitation of over 80 per cent of the iron with a corresponding regeneration of the nitric acid which has been consumed in forming ferric nitrate. The regenerated solution is then reused for pickling more sheet steel.

Patent No.	Date	Subject	Inventor or Assignee
2,641,807	6/16/53	Ingot mold	United States Steel Corp.
2,641,830	6/19/53	Method of making corrugated tubes	Chicago Pump Co.
2,641,995	6/19/53	Billet marker	United States Steel Corp.
2,642,115	6/19/53	Straightening apparatus for tube-forming machines	Van Huffel Tube Corp.
2,642,163	6/19/53	Arch form for furnace roofs	E. E. McVey and J. H. Opre
2,642,280	6/19/53	Apparatus for cold reducing metal bars	Gustaf L. Fisk
2,642,465	6/19/53	Method and apparatus for crystallizing naphthalene	United States Steel Corp.
2,642,468	6/19/53	Thermocouple mounting for use in molten steel	United States Steel Corp.
2,642,763	6/23/53	Cross rolling mill	Finn B. Abramsen
2,643,004	6/23/53	Lifting boom for ladle cranes for handling and open hearth tapping spout	United States Steel Corp.
2,643,009	6/23/53	Device for loading sheets or plates onto conveyors in shear line in a steel mill	Armco Steel Corp.
2,643,203	6/23/53	Method of and apparatus for removing slag from center hole of ingot soaking pits	Inland Steel Co.
2,643,460	6/30/53	Hardness testing indicator	Harry W. Dietert Co.
2,643,485	6/30/53	Production of lightweight aggregate from molten slag	Tennessee Valley Authority
2,643,544	6/30/53	Hardness tester	The Development-Research Corp.
2,643,558	6/30/53	Scrap briquetting press	Waldemar Lindemann and Fritz van Endert
2,643,757	6/30/53	Apparatus for delivering lengths of sheet to a feeding table	Bethlehem Steel Co.
2,643,867	6/30/53	Cupola stack or tower	Claude B. Schneible Co., Inc.
2,643,959	6/30/53	Protective treatment of iron with aluminum chloride in the vapor phase	Manufacturers Chemical Corp.
2,643,975	6/30/53	Method of lead coating a ferrous article	United States Steel Corp.
2,644,351	7/ 7/53	Scrap metal baler	Charles R. Golay
2,644,747	7/ 7/53	Hard-facing ferrous alloys	Louise J. Eder
2,644,774	7/ 7/53	Forming a sulfide coating on steel	Parker Rust Proof Co.
2,644,775	7/ 7/53	Method of bright annealing and cleaning	Hooker Electrochemical Co.

CLARK Bulletin 106 DC SHOE BRAKES need *Only One Adjustment* and that's TOPS!



There is *only* one adjustment ever needed—for lining wear. Simply loosen locknuts A and B. Turn adjustment bar until gauge nut is again flush with gauge rivet. Making this adjustment returns the brake to its original setting, providing correct shoe clearance, air-gap and torque setting.

You don't have to be a contortionist to make the *ONLY* adjustment necessary on Clark Bulletin 106 Shoe Brakes. This *ONE* adjustment, compensating for lining wear, is made *ON THE TOP*—not on the bottom, nor on the sides, nor on the ends—*JUST ON THE TOP*—that's where you can see it, and get at it easily.

These are the *only* brakes designed to fit the new 600 series Type Mill Motors . . . They operate on the "nut-cracker" principle, providing equal distribution of forces—and safe, dependable operation.

CLARK Bulletin 106 Brakes are simplest to adjust and extremely easy to install.

Your nearest **CLARK** *representative will gladly consult with you on Brake problems.*

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THE CLARK CONTROLLER CO.

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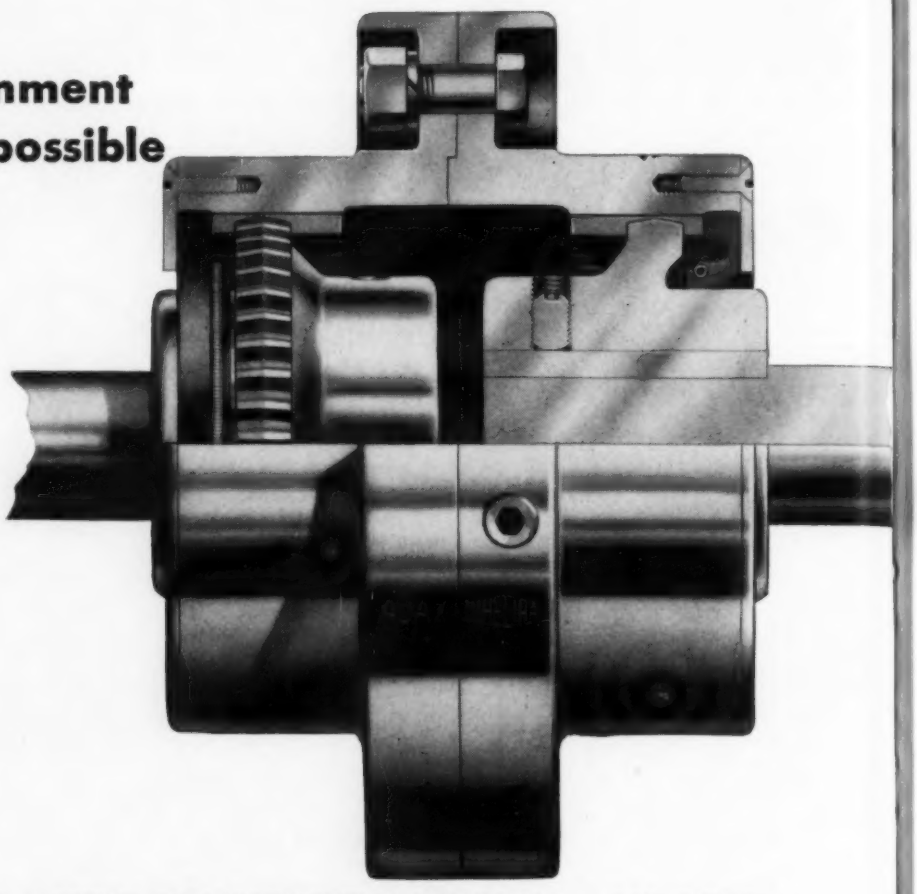
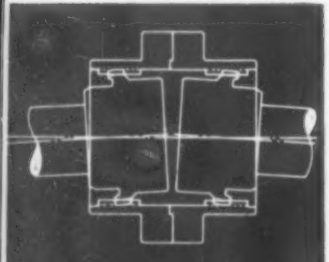
AJAX DIHEDRAL COUPLINGS

Protection against misalignment heretofore considered impossible

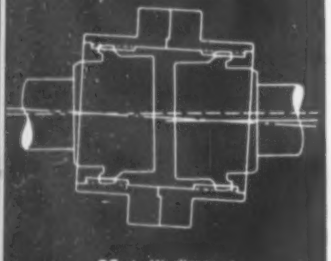


● The Ajax Dihedral Coupling is a radically new, different and efficient spline or gear-type coupling designed to handle shaft misalignment far beyond the capacity of conventional flexible couplings.

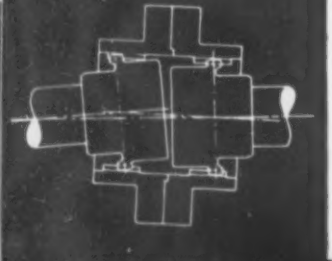
They simplify machine design, manufacturing, installation and maintenance by eliminating necessity for precision alignment of driving and driven shafts. Tooth clearance (backlash) is held to lubrication film requirements.



Angular Misalignment



Offset Misalignment



Offset and Angular Misalignment

LESS BACKLASH • MOST MISALIGNMENT CAPACITY • ALL GEAR TEETH HARDENED TO 50-55 ROCKWELL C.

● More tooth area is in contact under misalignment than is possible with any other shape of tooth. Load is carried at center of teeth at the point of greatest strength. No end-of-tooth contact to resist free end-float. All teeth are case hardened by induction combining hard wear surface with tough core. Positive seals keep lubrication in and dirt out.

Made in standard, mill motor and floating shaft types. Table gives basic sizes and capacities. Write for catalogs.

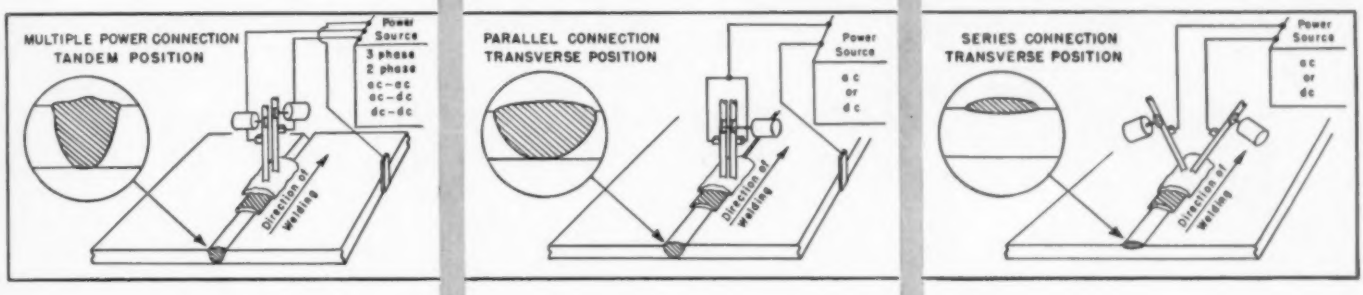
Coupling Size	Maximum Bore	Mandrel Bore	Capacity H.P. @ 100 R.P.M.	Maximum R.P.M.
150	1⅜	¾	12	12,000
200	2⅛	1	24	9,300
250	2⅝	1	48	7,900
300	3⅛	1½	77	6,800
350	3⅝	2	130	6,000
400	4	2	190	5,260
450	4½	2½	260	4,770
500	5	2½	350	4,300
550	5¾	2½	440	3,900
600	6½	3½	605	3,690
700	7¾	3½	965	3,220

AJAX FLEXIBLE COUPLING CO. INC.
2 ENGLISH STREET WESTFIELD, N. Y.

CUT YOUR WELDING TIME IN HALF *with* UNIONMELT Multiple Electrode Welding

UNIONMELT Multiple Electrode welding with two or more electrodes in tandem, transverse, or other positions increases welding speeds up to three or four times faster than single electrode welding.

By using two or more electrodes in the same weld zone, magnetic reaction can be regulated to provide exceptional control over arc direction and weld shape.



Extra High-Speed Welds are made with multiple power connection and the electrodes in the tandem position. Speed is three to four times that of single electrode welding. This is particularly suited for welding long continuous seams, well-prepared and well-fitted, as in pipe, tanks, pressure vessels, and structural assemblies.

Extra Wide, High-Speed Welds are made with parallel power connection and the electrodes in the transverse position. Speed is twice as fast as for single electrode work. This is particularly useful for welding seams with gaps or other irregularities, as in center sills, ship plate, and heavy, hard-to-fit work.

Extra Shallow, Wide Welds are made with the series power connection and the electrodes in the transverse position. Speeds are many times faster than single electrode work and the dilution of the deposit is far lower than can be produced with a single electrode. This process will open new possibilities for surfacing and cladding all kinds of articles by automatic welding.

Complete UNIONMELT machines are available for multiple electrode welding and all UNIONMELT apparatus is designed for easy installation in any plant or factory. LINDE's engineers will be glad to determine how UNIONMELT Multiple Electrode Welding can best benefit you. Call your nearest LINDE office for more details on UNIONMELT Multiple Electrode Welding.

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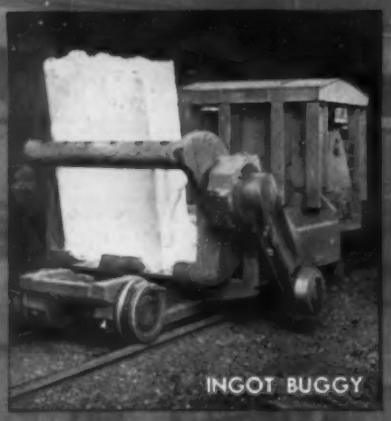
INGOT BUGGY

From 6-ton ingot... to fine and true gage strip, in a straight line from one original heat!

BLISS-BUILT hot mill for Empire Steel combines new and rebuilt equipment to save time and investment

Engineering a complete hot strip mill is no minor assignment at best. But when higher production goals must be reached, partially with existing machinery, the assignment becomes a real challenge.

In all, 30 complex units (mills and auxiliary equipment) were involved. Empire established the requirements, budget and time table. Existing machinery would be used as much as possible, but *rebuilt*, *repowered* and *modernized*. Completely new mills and accessories were to be added for certain vital operations. These were the requirements presented to Bliss—*who engineered the entire project.*

This highlight picture sequence gives some idea of the project's scope. The new objective called for transforming 6-ton ingots into hot rolled strip of fine tolerance... in a straight line and from the original heat! And the strip production had to yield sheet stock which, through subsequent finishing operations, would meet the trade's exacting specifications. This demanded Empire-Bliss teamwork, comprehensive field research, creative engineering at the site and at home, and unusual resourcefulness on the part of Bliss engineers.

In production now, Empire's new hot strip mill has met every test successfully. Quality and output have reached anticipated goals. But this is just one example of Bliss' ability to supply the special skills, knowledge and service to meet specific requirements. Next time you have a rolling mill problem, talk it over with a Bliss engineer. The chances are good that Bliss will supply the best practical solution.

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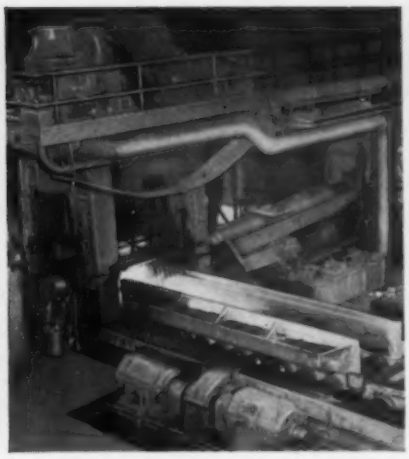
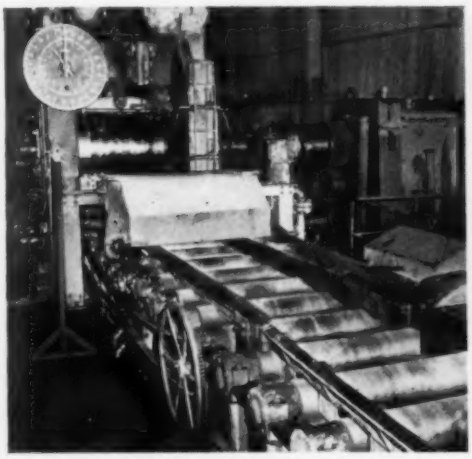
2. INGOT CROSS TRANSFER AND APPROACH TABLE

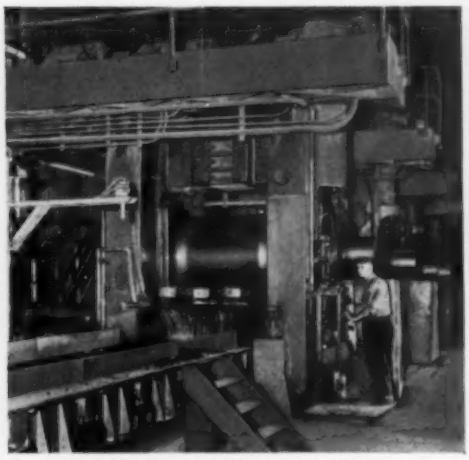


3. BLOOMING MILL—Revamped; supplemented with heavy mill tables

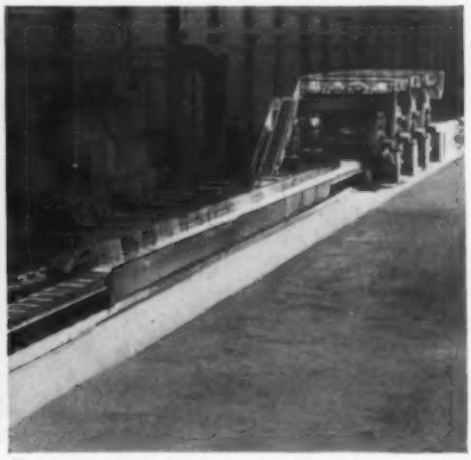
4. EDGING STAND of 1500 HP—designed new and to complement existing bloomer



5. INTERMEDIATE ROUGHER—Modernized

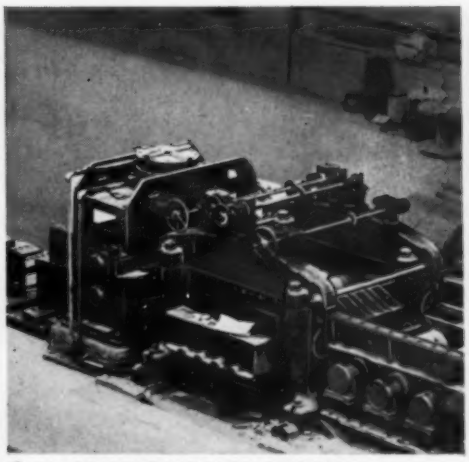


6. FOUR-STAND FINISHING TRAIN—Delivery end



7. RUNOUT TABLE to upcoiler and shear line

8. HOT STRIP COILER—Revamped



9. HEAVY-DUTY ROLLER LEVELER AND SHEAR

10. TERMINAL POINT OF LINE—Finish leveler and plate piler

Want a practical solution to your rolling mill problems? Do as Empire Steel Corporation did. Ask Bliss to show you how you can combine your available resources with new machinery to realize new production objectives. It can save you time and money, too.

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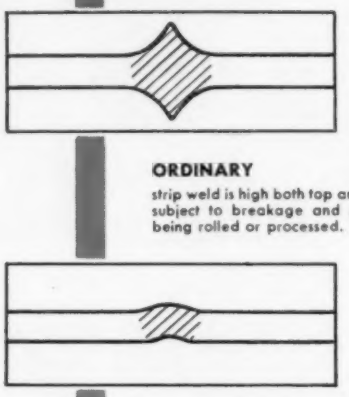
AT LAST!

a coil splice weld that is invisible and indivisible



ORDINARY
strip weld is high both top and bottom, non-malleable, subject to breakage and requires trimming before being rolled or processed.

ARMS-FRANKLIN SPLICE WELD
is slim contoured, highly ductile, stronger than the parent metal and enters mill rolls without any preparation. When rolled it's nearly *invisible* and *indivisible!*

INVESTIGATE THE ARMS-FRANKLIN *Weld-a-matic* COIL SPLICER*

*Pats. Pending

for carbon strip • silicon • stainless aluminum • copper • brass

Now you can increase the production of your strip operations by making them truly *continuous* with a constant supply of end-welded coils or, more nearly continuous through the use of larger built-up coils spliced securely by the Arms-Franklin *Weld-a-matic* Coil Splicing Method.

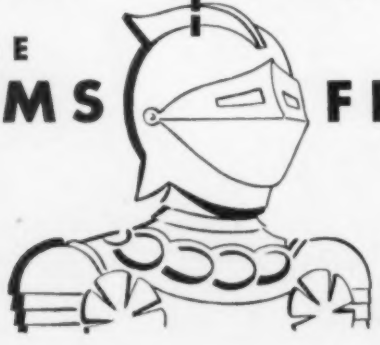
The Arms-Franklin *Weld-a-matic* Coil Splicer is a complete unit designed especially to suit your operation. It end-welds coils with a highly ductile, streamlined weld that is stronger than the parent metal, not subject to breakage, and requires no trimming before entering mill rolls or processing lines.

When rolled, the weld is almost invisibly blended with the metal. Installations have been built to handle strip widths up to 94″. Coil splicing has been successfully accomplished on carbon, stainless, and silicon steels, aluminum, copper and brass. All operations are hydraulic, push button controlled, and automatic . . . requiring no welding skill or special training.

To make your continuous operations *truly* continuous or to reduce downtime by using larger, built-up coils, investigate the A-F *Weld-a-matic* Coil Splicer. Write on your company letterhead for complete descriptive bulletin.

TYPICAL ARMS-FRANKLIN CUSTOMERS

Allegheny-Ludlum
Alcoa
Armco
American Steel & Wire
Bethlehem Steel
A. M. Byers
Chase Copper & Brass
Crucible Steel
Dow Chemical
Follansbee Steel
Inland Steel
International Nickel
Jones & Laughlin Steel
National Tube
Pittsburgh Steel
Republic Steel
Sharon Steel
Superior Steel
Youngstown Sheet & Tube
United States Steel



THE ARMS FRANKLIN CORPORATION
YOUNGSTOWN 1, OHIO

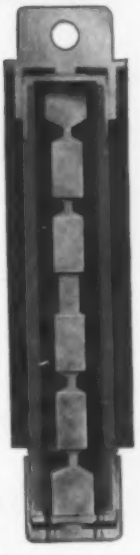
Producers of: **Strip Coil Splicers, Coil Build Up Lines, Cleaning and Pickling Lines, Annealing and Inspection Lines, Slitting Lines, Grinding Lines, Cut to Length Lines, Payoff Reels, Tension Reels, Levellers, Shears, Classifiers and Other Auxiliary Equipment**

WE PUT THE "CONTINUOUS" IN CONTINUOUS MILLS

Oil Immersed

SAFETY LINE DISCONNECT SWITCHES

30 - 60 - 100 - 200 - 400 - amp. available for 250 and 600 volt service



Cutaway view (right) shows unique design of Rowan low-voltage AIR-SEAL fuse for use under oil.

Rowan Type 620-A Line of Safety Disconnect Switches are designed to provide dependable service in all locations especially where the atmosphere is corrosive or charged with semi-hazardous dust or vapors such as chemical plants, oil refineries, steel, and cement mills. A few of the outstanding features of these switches include:

1. Completely oil immersed. 2. Equipped with Rowan time-tested AIR-SEAL fuses. 3. Disconnect switch of the quick-acting contactor type with renewable contacts. 4. Top and tank are mechanically interlocked with the disconnect switch to prevent lowering of tank when switch is in operating position or closing of switch when tank is lowered. 5. Provision for padlocking disconnect switch in the OFF position. 6. Enclosing case is weather resisting. 7. Unique arrangement for lowering tank for inspection without removing tank from unit.

Enclosures are NEMA Type XI: NEMA Type VIII enclosures are available. Complete information available from Rowan representatives in principal cities of the United States.

ROWAN CONTROL

THE ROWAN CONTROLLER CO., BALTIMORE, MD.

Specify HAGAN
RING BALANCE FLOW METERS

and you get

- **Ease of dead weight calibration**
- **No stuffing boxes**
- **Mercury level not critical**
- **High sensitivity at low flow rates**
- **Adjustable full scale range**

This is the versatile Hagan Ring Balance Flow Meter

Models are available which will record, indicate and integrate two flows on a single chart. Standard modifications provide pressure and temperature compensation. Ring assemblies available can measure differentials from 1″ to 420″ water column maximum at static pressures up to 3,000 psig.

HAGAN RING BALANCE METERS provide dependable, accurate flow measurement of oxygen, water, steam, gas, oil or other fluids. Design is simple, maintenance costs low.

• • •

For more information about Hagan Ring Balance Flow Meters, and how they can help you solve your metering problems, fill out the coupon.

Clip this coupon for information

HAGAN CORPORATION
HAGAN BUILDING, PITTSBURGH 30, PA.

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
CONTROL SYSTEMS FOR AUTOMOTIVE AND
AERONAUTICAL TESTING LABORATORIES

HAGAN
HALL
BUROMIN
CALGON

Hagan Corporation
Hagan Building
Pittsburgh 30, Pennsylvania

Please send me further information on Hagan Ring Balance Meters. I am particularly interested in .....

.....

NAME .....

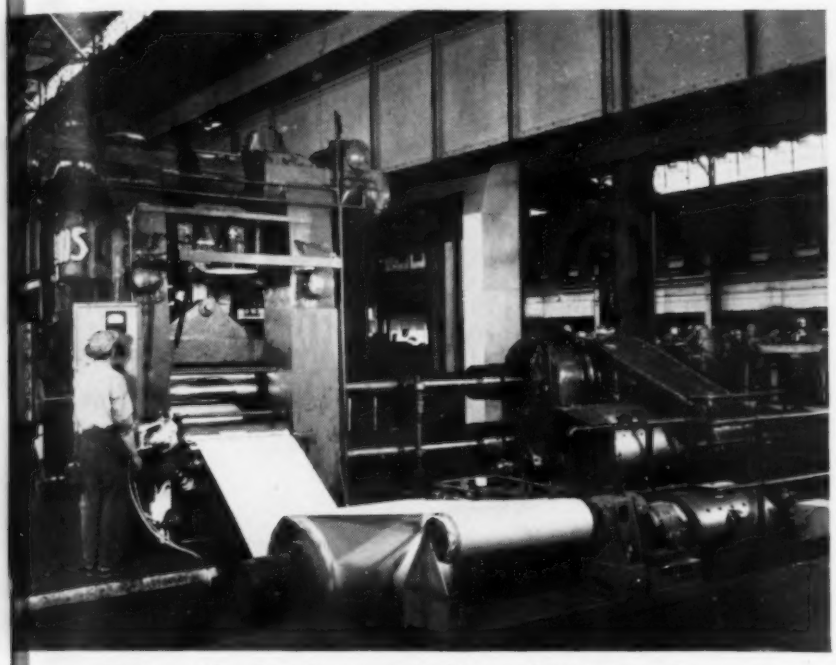
POSITION .....

COMPANY .....

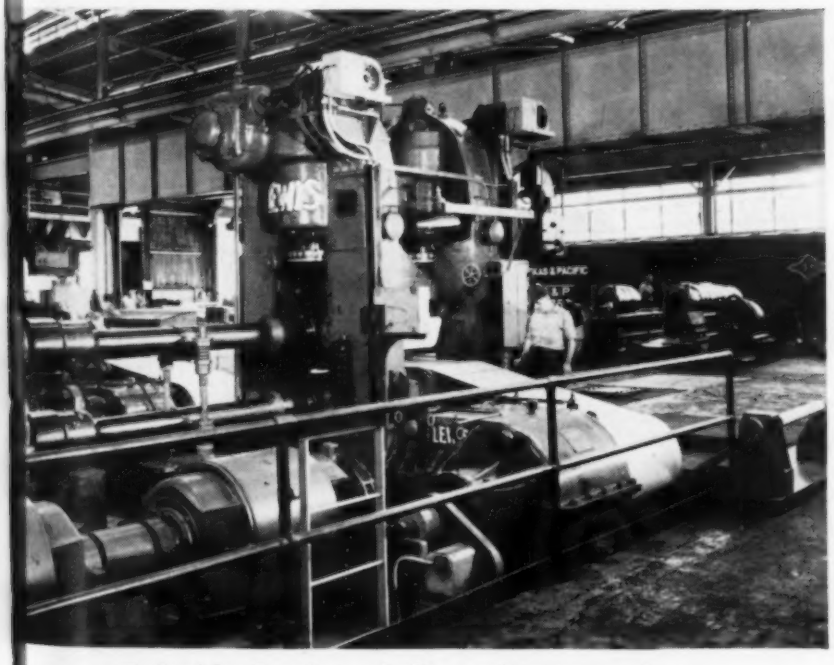
STREET AND NUMBER .....

CITY ..... ZONE ..... STATE .....

"It's a real 'bonus' maker"



Entry side showing unwinder and paper reel



Exit side showing winder and paper reel

That's the expressed opinion of roll bosses who have noted the high productive capacity and extreme accuracy of gauge of the new

28" x 42" TWO-HIGH

LEWIS

SKIN PASS

MILL

Like all Lewis equipment, this efficient mill was designed by experienced engineers who know the problems of both owners and operators. If your operation also could profit from this high-speed finisher we would be pleased to discuss details.

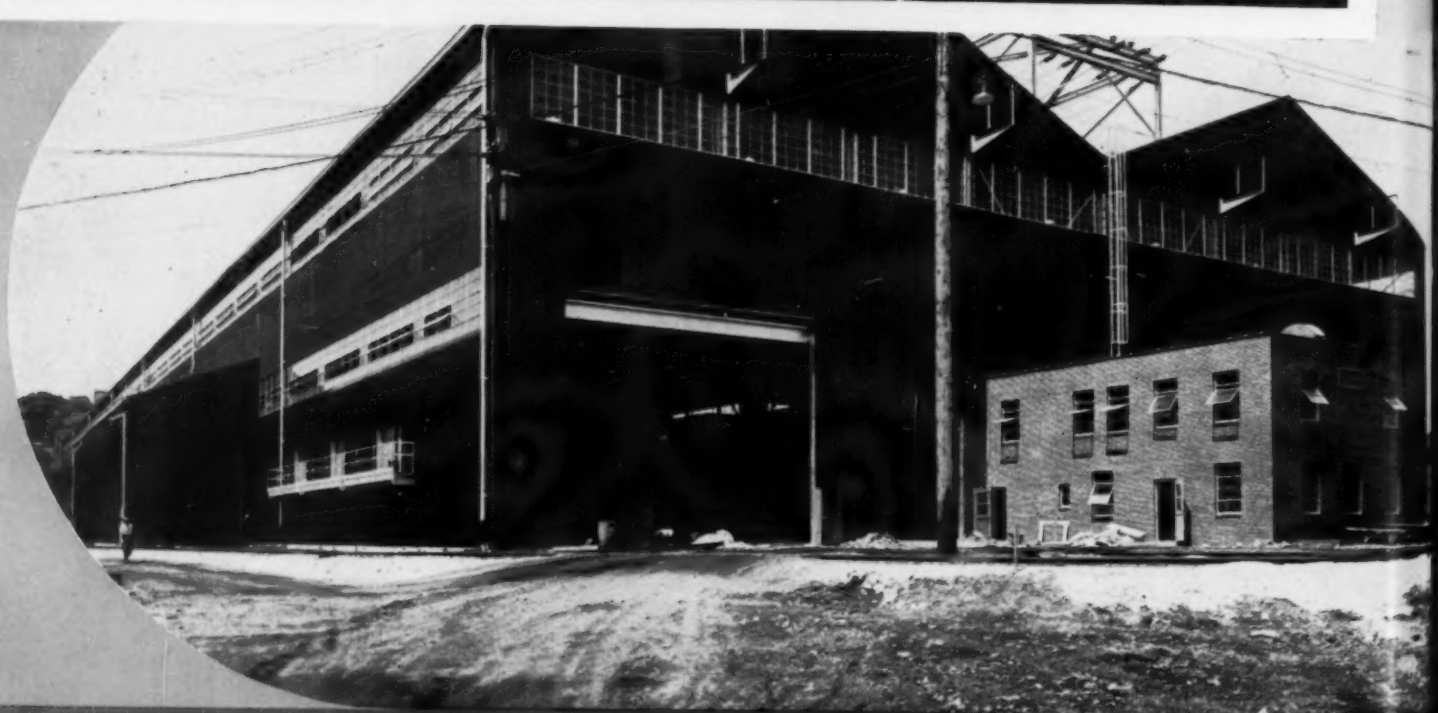
BLAW-KNOX

BLAW-KNOX COMPANY
LEWIS MACHINERY DIVISION
PITTSBURGH 22, PA.

BLAW-KNOX

Engineers and constructors

SWINDELL



The
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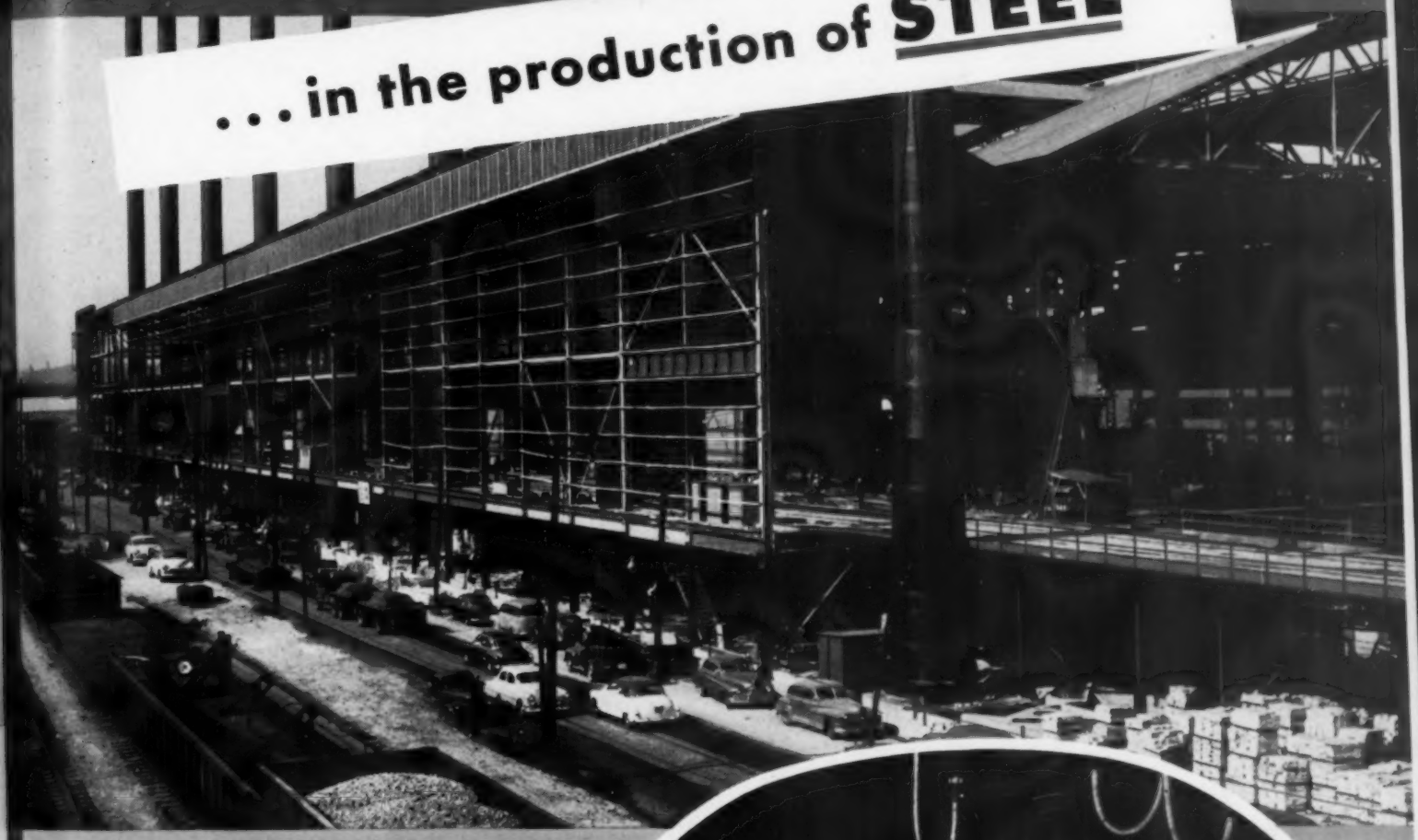
-DRESSLER

. . . in the production of STEEL



The engineering of steel-making facilities "from the ground up" is a major activity of Swindell-Dressler. • Whether the task is the construction of buildings and furnaces for a new electric melting shop (at left), or the engineering and management supervision of a gigantic open-hearth development in all its ramifications, Swindell-Dressler has the resources, the capacity and the experience for the job. • Let us discuss your coming requirements.

SWINDELL-DRESSLER *Corporation*

PITTSBURGH 30, PENNA.

Hot rolls 5" square stock, holds ±0.005" tolerances with TIMKEN® bearings

BLISS engineers were faced with the problem of handling severe loads set up as 5" square stock is hot rolled to 3⅞" in just six passes. After careful study, Timken® bearings were selected for the main roll necks as well as worm, bevel, high and slow speed shafts of their 2-Hi reversible mill.

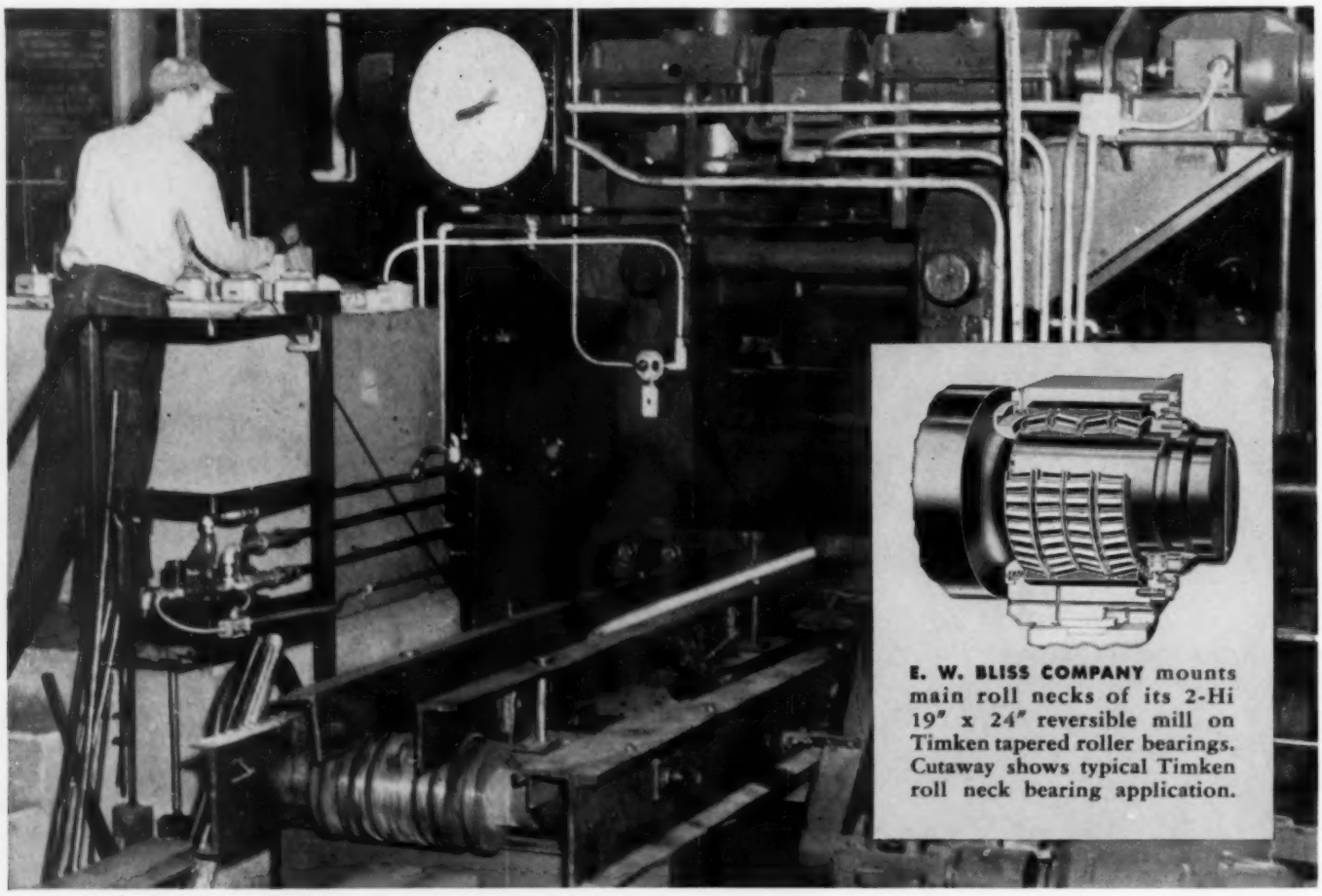
Higher rolling mill speeds are possible on Timken roll neck bearings. Lower starting resistance of Timken bearings permits mills to accelerate more rapidly. Skidding between work roll and back-up roll is reduced.

By permitting the use of simple and economical grease lubrication, Timken bearings eliminate complicated lubrication systems. Rolls can be changed quickly and easily.

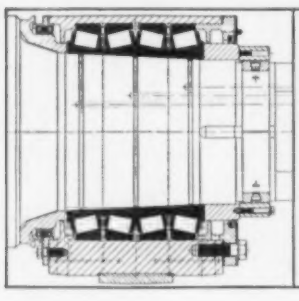
No special thrust bearings are needed because Timken tapered roller bearings take radial and thrust loads in any combination. And Timken bearings can take the heaviest of loads. Line contact between their rollers and races gives Timken bearings load-carrying capacity to spare.

Why not get all the advantages of Timken bearings in *your* mills? For complete information, consult our roll neck specialists. Write The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



E. W. BLISS COMPANY mounts main roll necks of its 2-Hi 19" x 24" reversible mill on Timken tapered roller bearings. Cutaway shows typical Timken roll neck bearing application.



4-ROW BEARING WITH TAPERED BORE

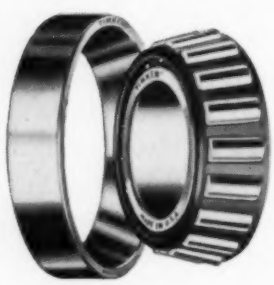
New 4-row Timken roll neck bearing with tapered bore combines interference fit with easy removal. It's the greatest development since the balanced proportion bearing!

The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacture; 3. rigid quality control; 4. special analysis Timken steels.

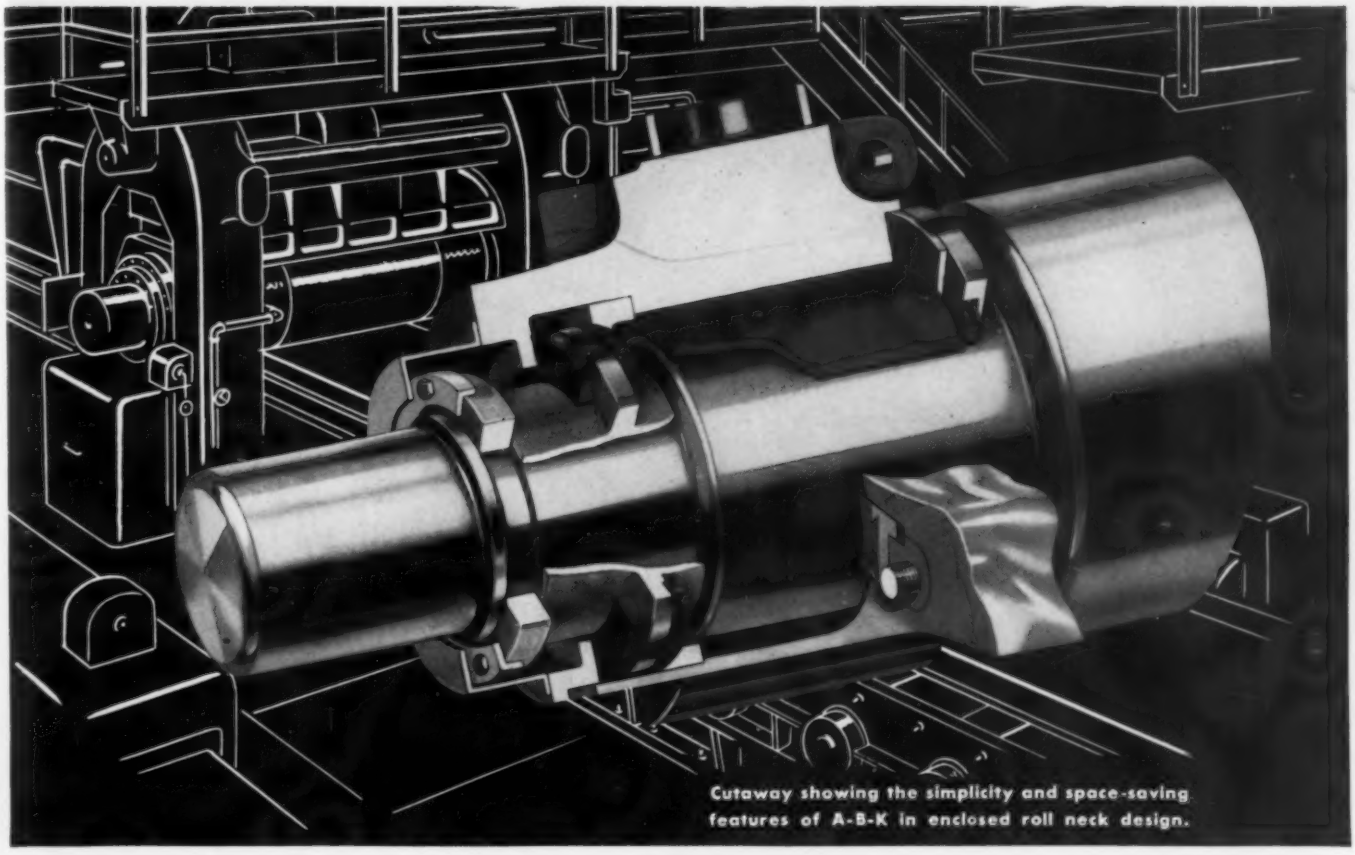
TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ↓⊙↑ AND THRUST →⊙← LOADS OR ANY COMBINATION →✳←



Cutaway showing the simplicity and space-saving features of A-B-K in enclosed roll neck design.

Operating Advantages of Enclosed Neck Design using A-B-K LAMINATED FABRIC BEARINGS

1. **MORE COMPACT BEARING ASSEMBLIES,** hence smaller castings and housings on original equipment.
2. **SIMPLE BEARING DESIGN,** needing fewer, less expensive parts and no special assembly equipment.
3. **LARGER NECK-TO-ROLL RATIOS,** thereby reducing possibility of roll breakage.
4. **IMPACT LOADS CUSHIONED** because of greater resiliency of nonmetallic bearings.
5. **LESS COST TO INSTALL and MAINTAIN,** are light in weight, need no special handling or protection in storage.
6. **WATER LUBRICATION** minimizes grease and oil usage.
7. **ROLL MAINTENANCE COSTS CUT,** won't score or heat check, protect roll necks.

A-B-K®
LAMINATED FABRIC BEARINGS

AMERICAN Brake Shoe COMPANY

Copyright 1953, American Brake Shoe Company

AMERICAN BRAKEBLOK DIVISION
DETROIT 9, MICHIGAN
IN CANADA: JOSEPH ROBB & CO. LTD., MONTREAL, QUEBEC

This Limit Stop not only *disconnects* the motor from the line, but *stops* the motor quickly. On D-c cranes, where high hoisting speeds prevail, dynamic braking aids in bringing the hook block to rest.

Since this Limit Stop is operated directly by the hook block, stretching of the hoisting cables does not affect the tripping point. By removing the fear of an overhoisting accident, the YOUNGSTOWN Limit Stop enables the crane operator to do better work.

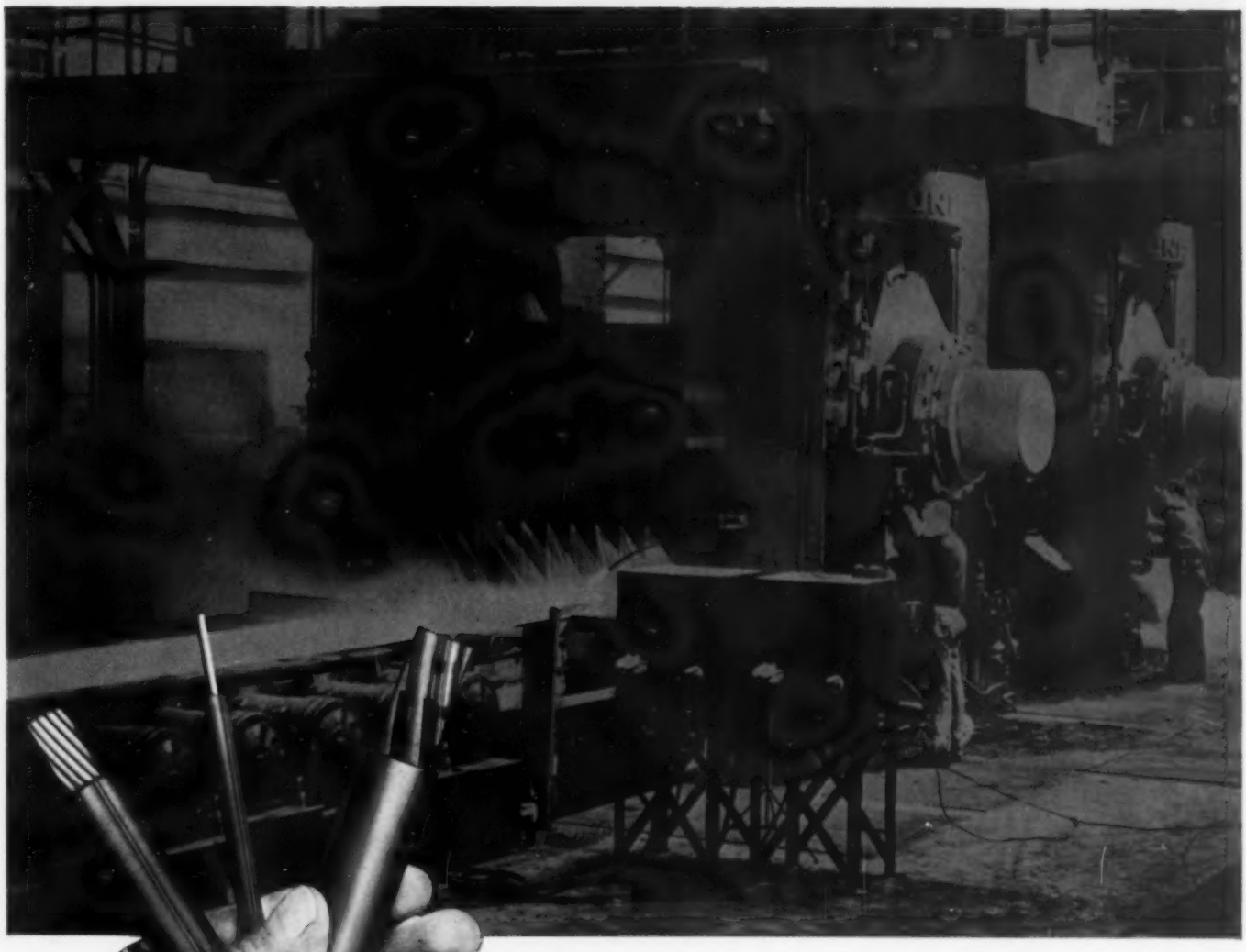
*A crane *without* a Youngstown is as risky as a boiler *without* a safety valve.

Easily applied to both new and existing A-c and D-c Cranes.

WRITE FOR BULLETIN 1032

E&M

THE ELECTRIC CONTROLLER & MFG. CO.



how to lower cable costs...
specify OKOLITE-OKOPRENE

Specify electrical cable that is designed for tough jobs—that can resist heat, flame, moisture, dirt, mechanical damage and corrosive chemicals and you will reduce cable costs. Cable that can survive such steel mill conditions will give the best service at the lowest cost. You avoid unnecessary maintenance expense, production time losses and the cost of replacing cable that has worn out prematurely when you put Okolite-Okoprene cables on the job.

Okolite-Okoprene has proved itself to electrical men in the steel industry by a long record of trouble-free operation. The famous Okoprene protective sheath, an exclusive Okonite neoprene compound, will outperform any of the usual types of cable covering.

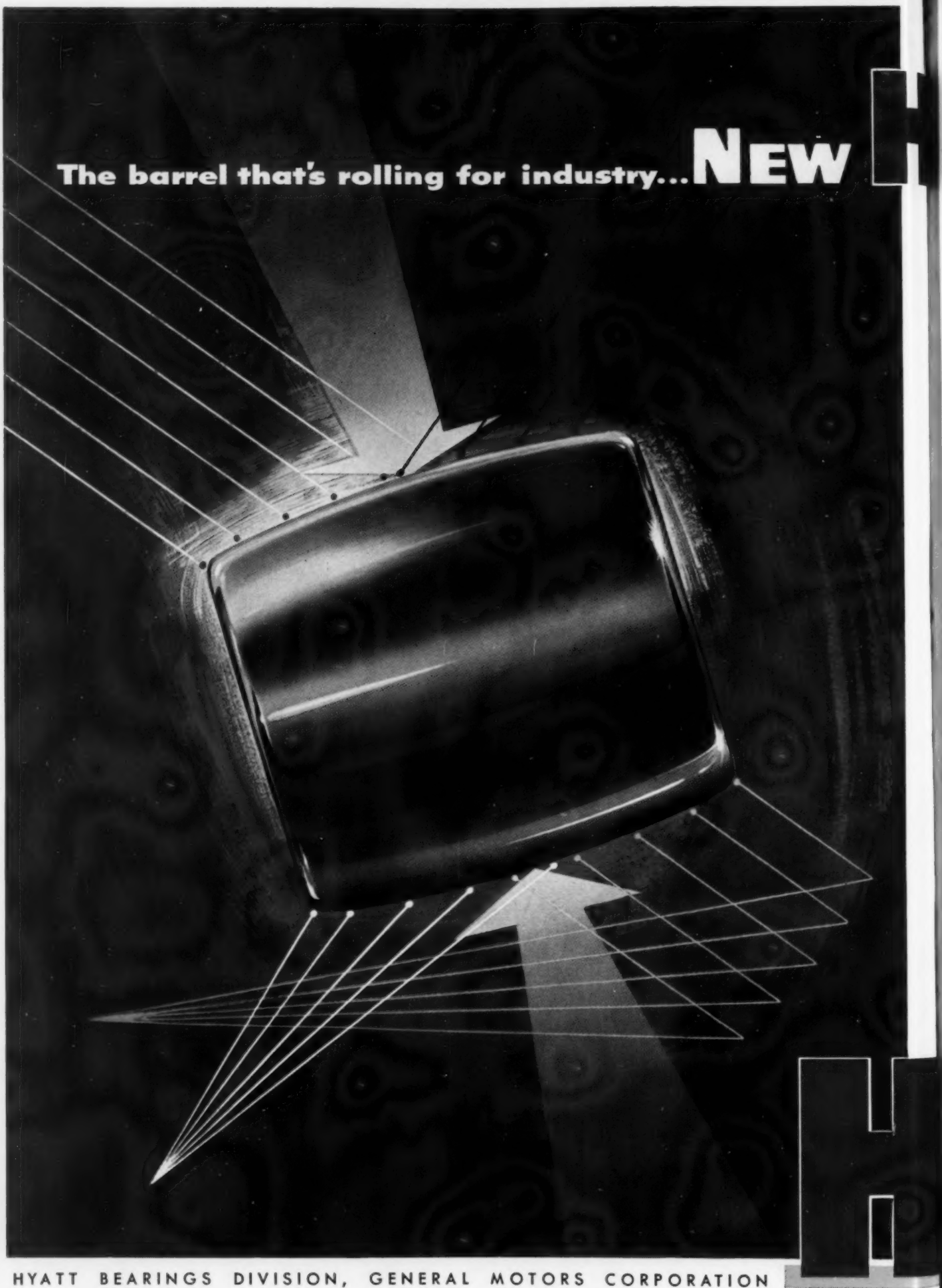
Additional life is given to the cable because it is made by the unique strip process which applies the insulation and sheath simultaneously. Long-lasting, high mechanical and electrical strength is assured by the perfectly centered conductors which are uniformly vulcanized in a continuous metal mold.

Bulletin IS - 1053 provides more information on the outstanding performance of Okolite-Okoprene. Write for it today to The Okonite Company, Passaic, N. J.

OKONITE SINCE 1878 *insulated cables*

75th ANNIVERSARY

1718



HYATT BEARINGS DIVISION, GENERAL MOTORS CORPORATION

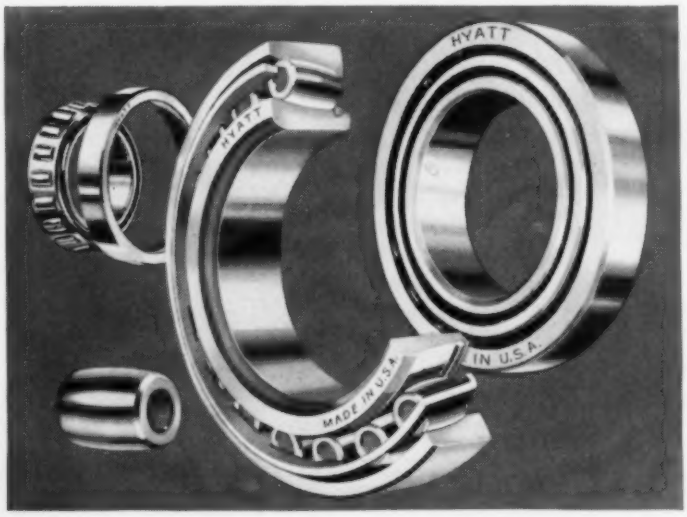
HYATT BARREL BEARING

now available in volume!

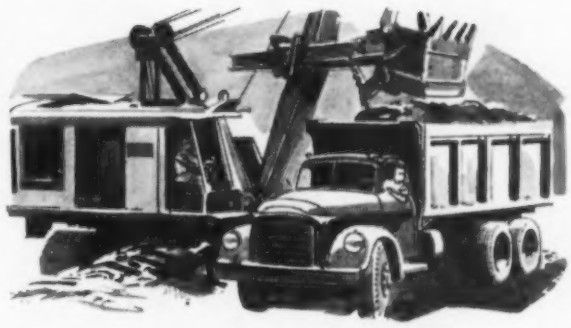
Hyatt is rolling out the barrels! . . . and a familiar shape is giving a big lift to modern industry! A new Barrel Bearing —pioneered and perfected by Hyatt—is available in volume for the first time! There's no other bearing quite like it—and it's ready for a starring role in industrial production!

The Barrel name comes from the barrel shape of the rollers . . . but its superiority in bearing applications comes from *dual-purpose design* and *self-aligning ability!* This unique bearing takes load from any direction . . . and operates at full load-carrying capacity under conditions of misalignment! And in addition, the barrel shape of the rollers combines the low rolling friction of a ball with the high load capacity of a cylindrical roller—so that the Barrel Bearing is ideal for a wide range of applications.

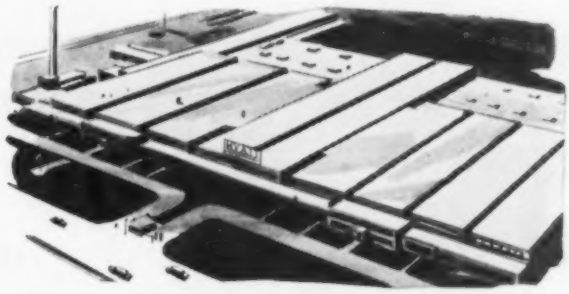
Expensive? *Not at all!* Advanced manufacturing processes —plus the facilities of one of the newest and finest bearing plants in the world—make the initial cost far lower than you would expect! . . . For full information on this newest solution to the friction problem, write to the address below.



Self-aligning action makes the Barrel Bearing ideal for tractors and farm implements. Over many years, its durable, dependable performance has been established in a wide range of these applications.



In trucks and construction equipment, too, Hyatt's Barrel Bearing operates with full efficiency under conditions of heavy, multiple-direction loading. Unique roller and race design distributes the load over large areas of contact.



Hyatt's new plant, in Clark Township, N. J., is among the most modern in the world. New equipment makes possible advanced manufacturing processes, and research facilities are the finest in the bearing industry.

YATT

ROLLER BEARINGS

HARRISON, NEW JERSEY

THE EXPERIENCE and MANUFACTURE OF

LEWIS ROLLS

. . . Known and used wherever metal is rolled

OVER 90 YEARS OF ROLL MAKING

LEWIS

MANUFACTURERS OF ROLLS FOR THE IRON, STEEL AND NON-FERROUS INDUSTRIES

- SUPERIOR "X" ROLLS
- AJAX DUPLEX ROLLS
- LEWIS "X" AND "XA" ROLLS
- SPECIAL PROCESS ROLLS
- CLIMAX AND AJAX ROLLS
- PLAIN CHILLED IRON ROLLS
- SPECIAL TUBE MILL ROLL
- ATLAS, ATLAS "B" AND ATLAS "X" ROLLS
- MOLYBDENUM CHILLED IRON ROLLS

may we have the opportunity of studying your requirements, and submitting our recommendations

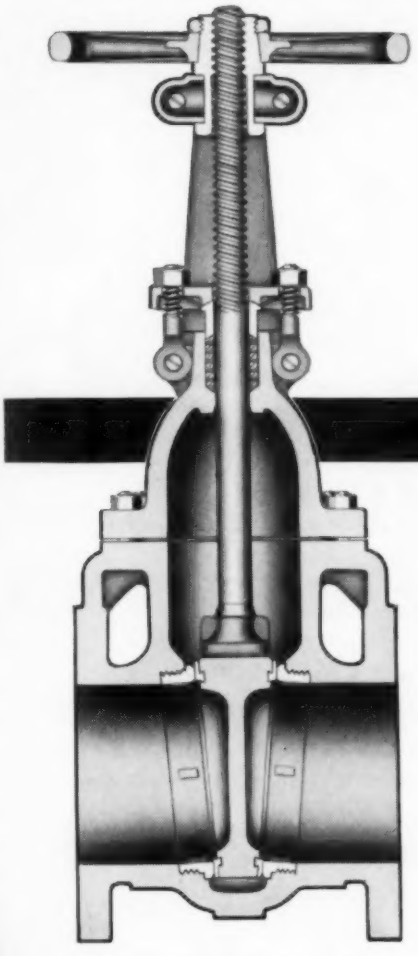
ROLLS DIVISION OF BLAW-KNOX COMPANY, PITTSBURGH, PA.

seating surfaces stay

Slick as a Whistle

...in CRANE 18-8 Mo ALLOY TRIMMED ALLOY CAST IRON GATE VALVES

This is the valve that cancels out seating surface corrosion economically in many piping processes. Its seats, disc, and stem are Crane 18-8 Mo alloy steel—an exceptionally high-grade stainless steel, highly resistant to most corrosive fluids.



NOW IN SIZES UP TO 18 INCHES

You'll recognize this valve pattern. It's the same as the famous Crane all-iron wedge gate, with the same liberal metal sections for maximum strength, and with tie-ribs on bonnet and end flanges for extra resistance to line strains. The big difference in these No. 14477 valves is: the body and bonnet are nickel low alloy cast iron, having much better physical properties and corrosion resistance than ordinary cast iron.

Cross-Section No. 14477
Crane Alloy Cast Iron Wedge Gate
18-8 Mo Alloy Trimmed
Flanged Ends
WORKING PRESSURES: 200 pounds cold water, oil, or gas, non-shock.
Sizes: 2, 2½, 3, 4, 6, 8, 10, 12, 14, 16 and 18 in.

TYPICAL APPLICATIONS

In the *Petroleum* industry, these valves are giving outstanding service on oils with traces of mineral acids . . . in *Wood Treating,* on creosote vapors and oils . . . in *Pulp and Paper* processing, on alkaline liquors of various kinds. In fact, No. 14477 valves are ideal for mildly corrosive services where all-iron valves are inadequate but where it is uneconomical to use all-stainless steel valves.

A new circular on No. 14477 gives complete specifications and lists new sizes available. Write direct, or ask your Crane Representative for a copy.

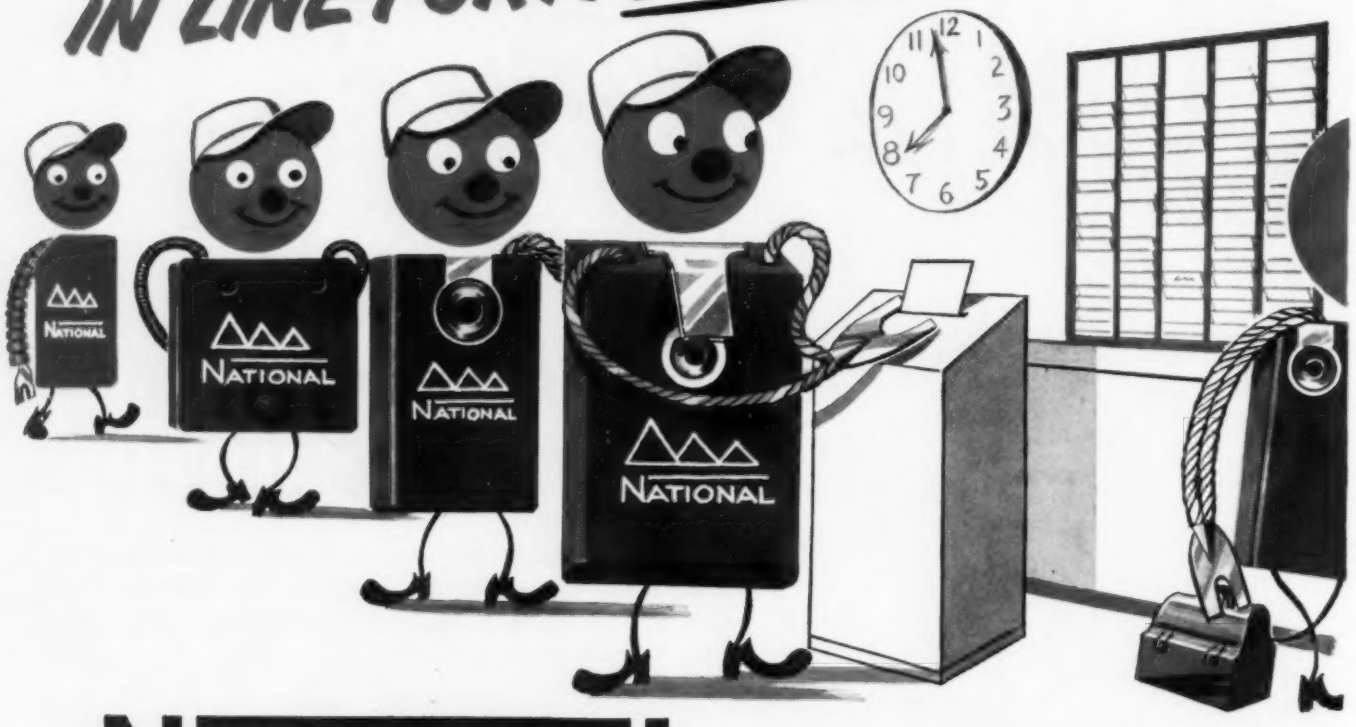
THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

IN LINE FOR A BETTER JOB...



NATIONAL BRUSHES FOR

TRADE-MARK

MAIN-DRIVE, MILL-TYPE and GENERAL-PURPOSE MOTORS

Here's what the "National" brush line will do for the operating departments of your company:

ELECTRICAL: National Carbon's concentration on uniform brush grades of wide-range applicability simplifies brush selection . . . helps you set up your own standardization program using fewer types and sizes.

MAINTENANCE: The low friction, superior commutating ability and long life of "National" brushes reduce commutator maintenance . . . cut costs and keep production at high sustained levels.

PURCHASING: Large numbers of stock and catalog items speed delivery of "National" brushes. And, remember, when you order "National" *Standardized* brushes, you really hit the jack-pot — low, flat prices regardless of quantity plus immediate shipment from stock.

STORES: National Carbon's improved packaging pays off in quick identification, ease of handling and stacking, fewer and sturdier cartons.

HOW GOOD IS REALLY GOOD BRUSH PERFORMANCE?
Write National Carbon Company

The term "National", the Three Pyramids device, and the Silver Colored Cable Strand are registered trade-marks of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.

District Sales Offices:
Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

In Canada: NATIONAL CARBON LIMITED
Montreal, Toronto, Winnipeg

NATIONAL STANDARDIZED BRUSHES
BETTER- PRODUCT-PACKAGE-PRICE- FASTER

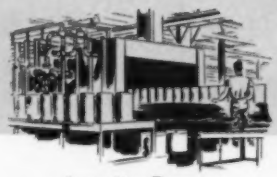
A guide for selecting temperature control for top furnace performance

Today, industry's need for lower operating costs ...reduced maintenance...high quality of production ... has spot-lighted the importance of "tight" furnace control.

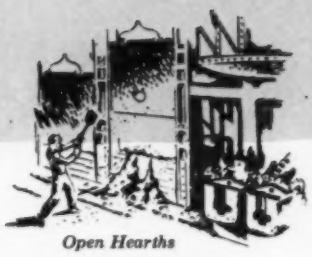
With closer specifications and higher control standards, more and more plants must pin down troublesome, costly departures from favorable heat-treating conditions.

To meet this demand, Leeds and Northrup has a complete line of matched temperature control systems available. You get equipment matched to your particular requirements. Each system comes to you as a "package" ready to handle the individual conditions created by your product, your production and your furnace.

There's an L&N control to match every industrial furnace



Annealing Furnaces



Open Hearths

TWO-POSITION CONTROL

For fuel-fired or electric furnaces

What it does:

Cuts heat input back to "low" when temperature exceeds control point . . . turns heat input on full when it falls below control point.

When to use it:

1. When changes in heat supply or changes in load are promptly "felt" by the temperature detector.

2. When alternate undershoot and overshoot will not damage product or process equipment, or slow down production.

3. When furnace pressure or fuel-air ratio *are not* controlled and the products of combustion *do not* form a protective atmosphere for the work.

PROPORTIONING-TYPE CONTROL

For fuel-fired furnaces

What it does:

Adjusts heat input by varying valve opening according to size of temperature change.

When to use it:

1. When there's a substantial time lag, before changes in heat supply or changes in load are "felt" by the temperature detector.

2. When load changes on continuous processes are both small and infrequent, and control point is rarely changed.

3. On batch process where operation is usually at the same temperature, and rapid recovery from upsets after loading is not important.

4. When furnace-pressure or fuel-air ratio *are* controlled, or the products of combustion *do* form a protective atmosphere for the work.

POSITION-ADJUSTING-TYPE CONTROL (P.A.T.)

For fuel-fired furnaces

What it does:

Adjusts heat input by varying valve opening according to size, duration and speed of temperature changes.

When to use it:

1. When there's a substantial time lag, before changes in heat supply or changes in load are "felt" by the temperature detector.

2. When load changes are both large and frequent and control point must be changed to suit various conditions.

3. When furnace design requires a continuously throttled flame.

4. When furnace-pressure or fuel-air ratio *are* controlled, or the products of combustion *do* form a protective atmosphere for the work.

5. Whenever overshoot is costly, hazardous or can cause damage to the product or heating equipment.

DURATION-ADJUSTING-TYPE CONTROL (D.A.T.)

For fuel-fired or electric furnaces

What it does:

Adjusts heat input by varying length of "heat on" time according to size, duration and speed of temperature changes.

When to use it:

1. When there's a substantial time lag, before changes in heat supply or changes in load are "felt" by the temperature detector.

2. When load changes are both large and frequent, and control point must be changed to suit various conditions.

3. When furnace design requires use of "on-off" operation of heat supply.

4. When furnace-pressure or fuel-air ratio *are not* controlled, and the products of combustion *do not* form a protective atmosphere for the work.

5. Whenever overshoot is costly, hazardous or can cause damage to the product or heating equipment.

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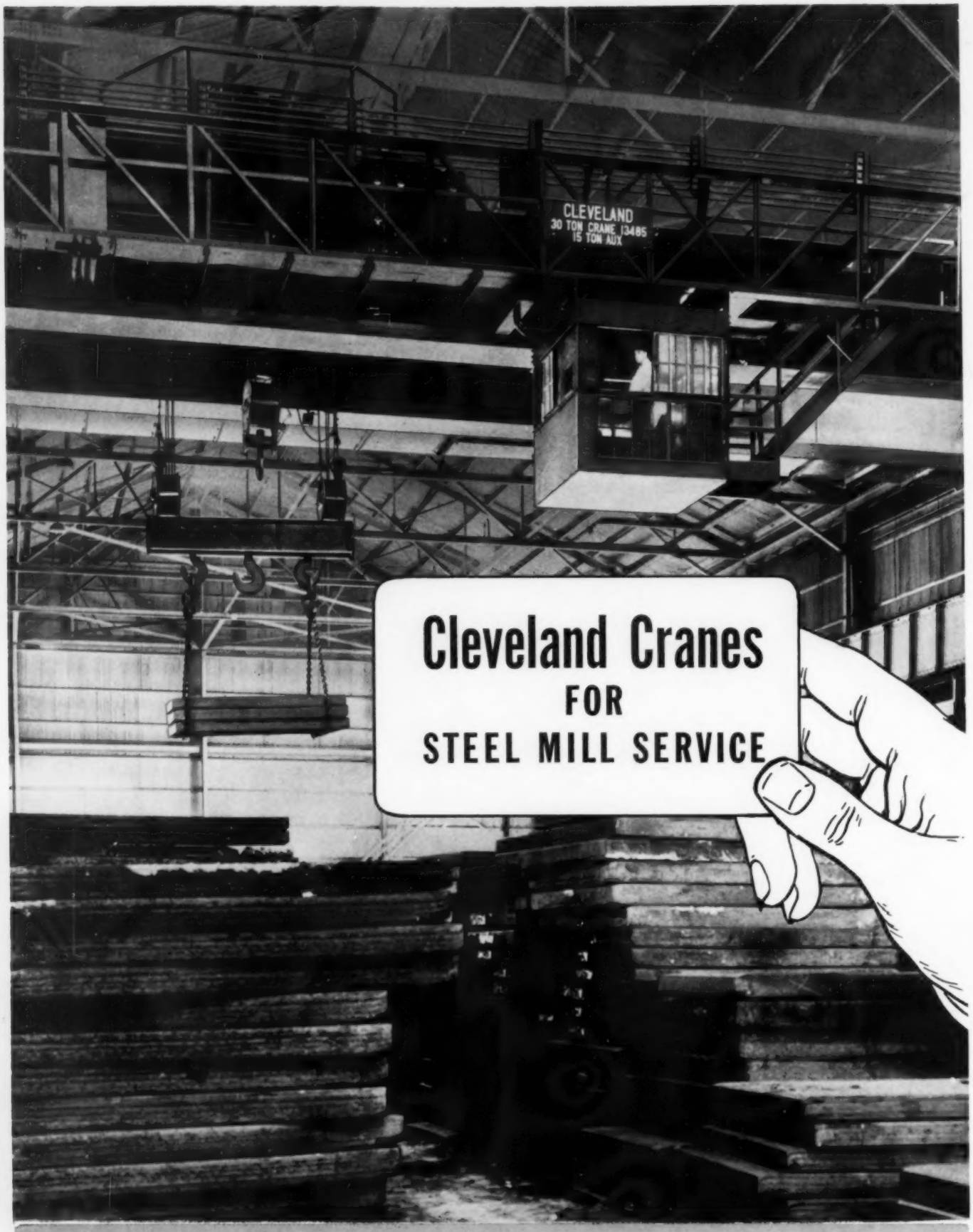

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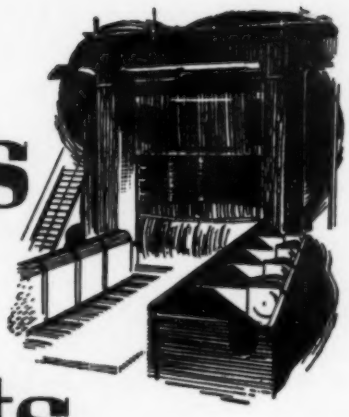


THE 1953 AISE convention is now a matter of history. With a registration of 2816 men and 249 women, plus an unknown number of non-registrants (shame on 'em!), and with an excellent technical program, this meeting was the best of its kind ever staged by the Association. The Association extends its thanks to all who cooperated to the success of this affair.

▲

A very commendable campaign is being waged by David J. McDonald, president of the United Steel Workers, to stamp out wildcat strikes. He insists that the contract must be held inviolate and that union protests must be handled through the grievance procedures set up in the contracts.

▲

WE like this gem from the Wall Street Journal:

The handy-mannish husband
Must do a lot of work
That men like me,
Who tend to be
Less capable, can shirk.

▲

STEEL production for the first eight months of this year totaled 76,622,609 tons. Adding the last four months of 1952 gives over 114,600,000 tons in one year's time.

▲

VARIOUS steel producers are more optimistic about early 1954 prospects. They believe that sheet business and oil country goods will be near capacity for the first quarter.

▲

IN spite of the cliche that gentlemen prefer blondes, we know some who prefer blends. Maybe they're the ones who are Scotch by absorption instead of by birth.

▲

EMMETT J. Leahy, management consultant, told the Society for the Advancement of Management that paper work is getting such a stranglehold on American industry that there are now as many clerks in business as there are farmers raising food for the entire country. Every year, a new file drawer is added to business archives for every one of the 62,000,000 persons employed. Much of this, he believes, can be eliminated. The average result of his surveys is the scrapping of 40 per cent of business records, removal of 30 per cent to dead storage, and retention of only 30 per cent in the office.

▲

THE modern home is a place where nothing can be accomplished if the electric current goes off.

▲

STATISTICS on highway accidents show some interesting trends:

	Per 100,000,000 vehicle miles	
	Accidents	Deaths
Two-lane roads	3.8	7.0
Four-lane, undivided	3.8	9.5
Four-lane, divided, controlled access	2.3	1.8

▲

THE old blooming mill engine at Jones & Laughlin's Aliquippa plant has, like old soldiers, faded away. Replaced by a new electric drive composed of four 3000 hp motors in the remarkable time of 7 days and 14½ hours, the old engine hung up 41 years of remarkable service, setting new world rolling records several times.

▲

INCIDENTALLY, they say that old bankers never die; they just lose their interest.

▲

DR. H. E. Luedicke, editor of the Journal of Commerce, has a neat verse applying to the immediate business future:

"Early to bed and early to rise,
Work like hell — and advertise."

▲

STAINLESS steel 0.0007 in. thick has been produced by Armco Steel Corp. on a small four-high mill in their research laboratory. Though not a commercial process, the cost of the product has been estimated at $2,000,000 per ton.

▲

ACCORDING to the American Iron and Steel Institute, new high levels were reached in July for average hourly earnings and total employment. Wage earners averaged $2.31, slightly more than double the figure of 10 years ago, and worked an average of 38.1 hours a week. Estimated total employment was 696,000.

▲

EVERY day we encounter more interest in the first western meeting of AISE, to be held in Los Angeles, February 15, 16 and 17, 1954. It begins to look like a real good affair.

News in 1940—production necessity today

ONLY a few years ago, the science of sensitive, accurate measurement was limited to laboratories. But today, this science is practiced every day in thousands of industrial plants by factory men . . . who don't have to be instrument experts.

Production men wanted to put this science to work, for they had long known that many processes would function at greater efficiency if temperature, pressure and other variables could be more accurately maintained. Although these potential benefits could be proved in the laboratory or in pilot plants, they could seldom be exploited fully in actual production.

Milestone in measurement

One of the main reasons was that existing industrial methods of measurement were not sufficiently accurate, sensitive or fast. Instruments with delicate mechanical balancing systems suffer inherent limitations . . . always require a compromise between sensitivity and ruggedness . . . and can provide only periodic measurements.

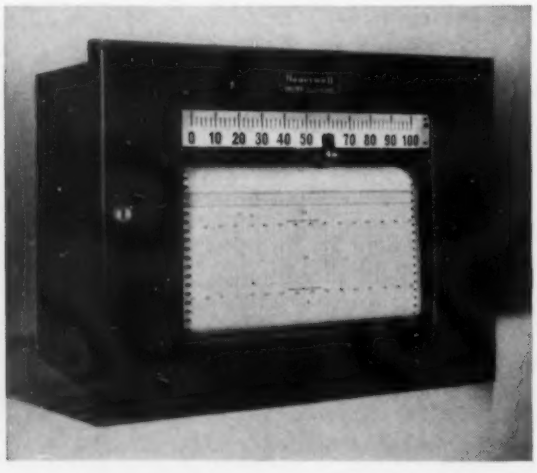
Then, in 1940, the advent of *ElectroniK* instruments swept away these limitations. By adopting an entirely new approach—electronic continuous balancing—these instruments revolutionized the concepts of industrial measurement. They placed laboratory accuracy and sensitivity at the disposal of the production man . . . with all the simplicity and ruggedness demanded by industrial service . . . *plus* speed of response never before economically practical.

Proved by years of performance

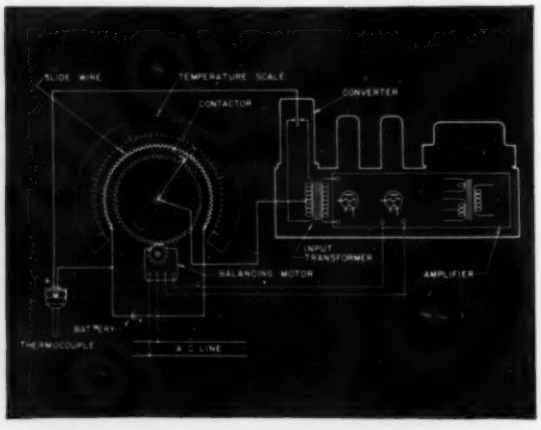
In the past thirteen years, thousands of plants have discovered almost endless applications where the superior performance of these instruments helps to improve operations. The more they learn about *ElectroniK* instruments, the more they call on them for increasingly complex tasks of measurement and automatic control.

Since 1940, the *ElectroniK* family has grown to encompass a host of new indicating, recording and controlling models . . . capable of measuring scores of different process variables . . . equipped with the most advanced types of automatic control. In anticipation of the needs of the future, Honeywell's intensive development program is bringing to readiness even more advanced equipment for tomorrow's process control problems.

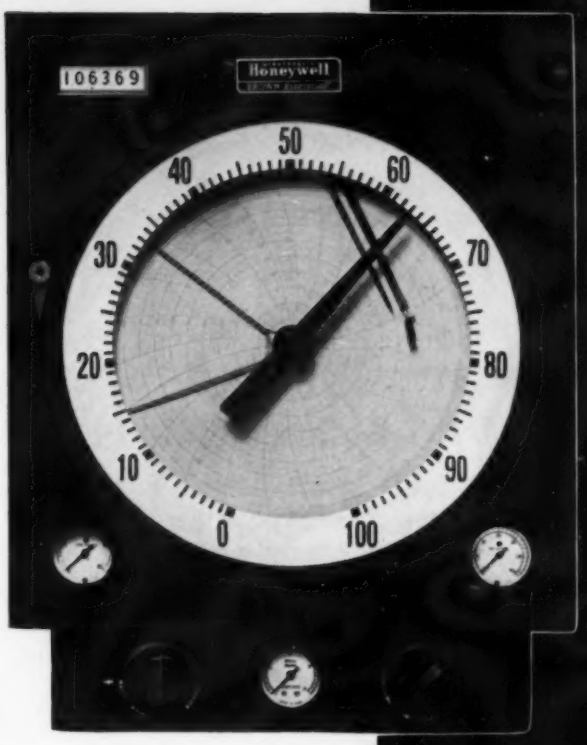
Versatile *ideal*

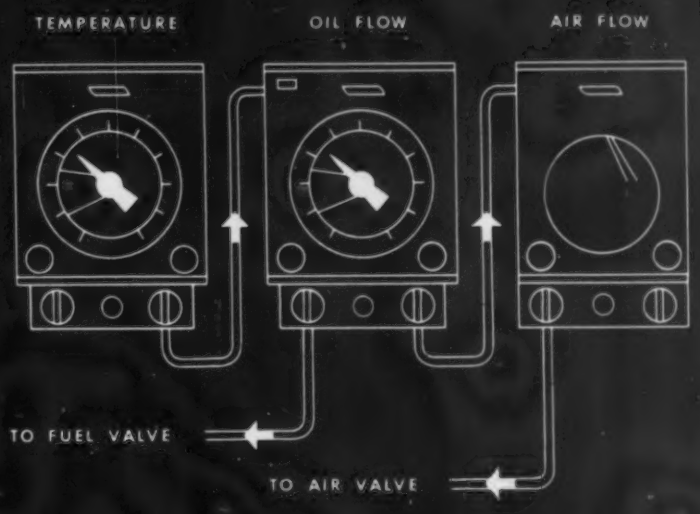


A FAMILIAR SIGHT *to thousands of production men, scientists and engineers is this strip-chart* ***ElectroniK*** *Recorder, one of a complete family of indicating, recording and controlling instruments.*



POWER PLANT *of* ***ElectroniK*** *instruments amplifies a millionfold the minute electrical signals from thermocouples and other sensing elements.*





Typical three-instrument interlocked control system for temperature and fuel-air ratio, utilizing *ElectroniK* Flow Meter.

ElectroniK flow meter— *for fuel-air ratio control*

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A fast, accurate counter adds up oil or gas flow, to aid in fuel cost accounting. In ratio control, a fixed or adjustable *Indexet* sets the control index from a remote transmitter. Electric transmission from the remote meter body spans any distance . . . provides instantaneous measurement. Meter body can be linear, square root, or area type.

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Iron and Steel ENGINEER

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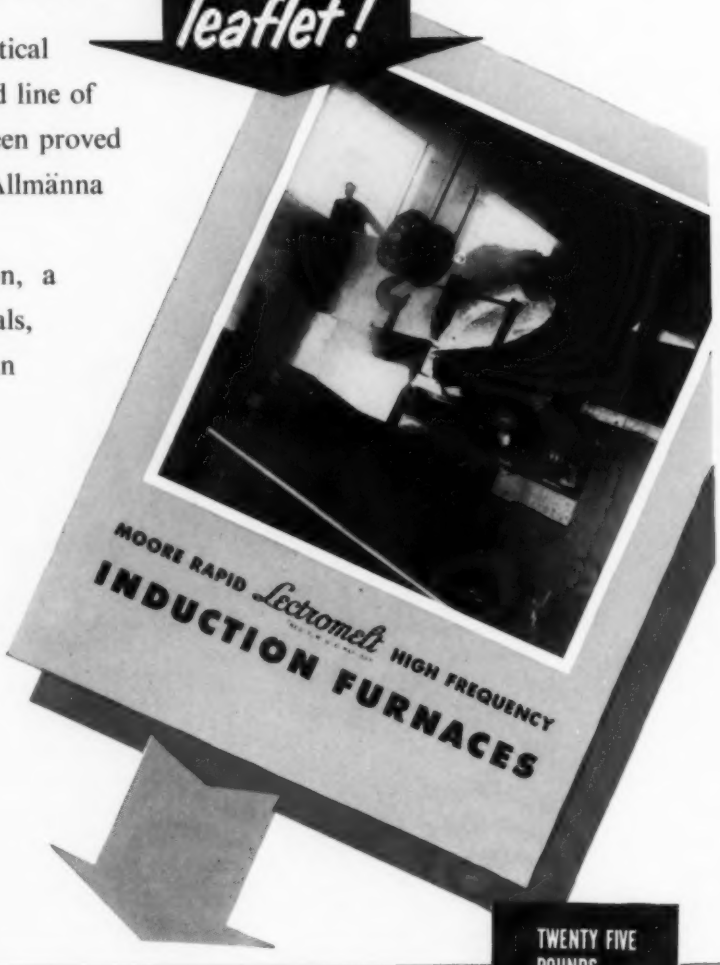


WHEN YOU MELT... MOORE RAPID *Lectromelt*

*REG. T. M. U. S. PAT. OFF.

MECHANICAL DESIGN AND OPERATION OF A MODERN 46 IN. HIGH LIFT SLABBING-BLOOMING MILL

. . . . part of the expansion program at the Pittsburgh Works of the Jones & Laughlin Steel Corp. is a new 46-in. blooming-slabbing mill . . . .

By J. H. MAYER
Assistant Superintendent
Blooming Mill Dept.
Jones and Laughlin Steel Corp.
Pittsburgh, Pa.

J. H. MAYER

▲ THE purpose of this paper is to present a general description of the 46-in. slabbing-blooming mill, recently completed at the Jones & Laughlin Steel Corp., Pittsburgh works, with emphasis on the layout and flow of product.

The blooming mill, shears, pilers and soaking pits are housed in a building 680 ft long, with a continuous crane runway and a repair trolley from the soaking pits to the pilers. Mercury vapor lights are installed throughout the mill, to produce 20 footcandles of light. Ample lighting helps to keep the mill area clean at all times, as dirt becomes very evident under lighting of such intensity.

The floor space around the mill equipment is approximately 17,000 sq ft, and is paved. This large paved area is conducive to better operations, maintenance, and truck and railroad facilities.

In the soaking pit area, there are one standard gage and one narrow gage railroad track which provide for delivery of ingots from the new eleven open hearth furnaces, and our No. 2 open hearth shop. There is also an adequate area for the banking of ingots when necessary.

The flow of material or product is the same as any conventional slabbing mill. Ingots of various sizes and grades can be heated in either of two soaking pit buildings. The reason for two buildings for soaking pits is due to having previously built modern top-fired pits in the other blooming mill building, adjacent to the newly erected one. This made necessary the installation of a semi-automatic ingot buggy and transfer for the fast movement of ingots.

Ingots from the new pits are conveyed to the mill by a semi-automatic, motor driven pot car which dumps the ingot onto the first of a series of tables, from which the ingot travels to an automatic scale, where it is weighed, then to the mill rolls. After rolling to proper size, temperature is automatically recorded as product is being conveyed to the shears. After shearing, stamping and check weighing, product moves to the pilers, is piled and conveyed to cooling area close to conditioning beds, or loaded on rack cars for shipment. This arrangement provides a straight line flow of ingot to product.

Let us elaborate on the design and operation of the equipment in relation to product flow.

SOAKING PITS

As stated, the new soaking pits are located in line with the entry end of the mill, under a crane runway

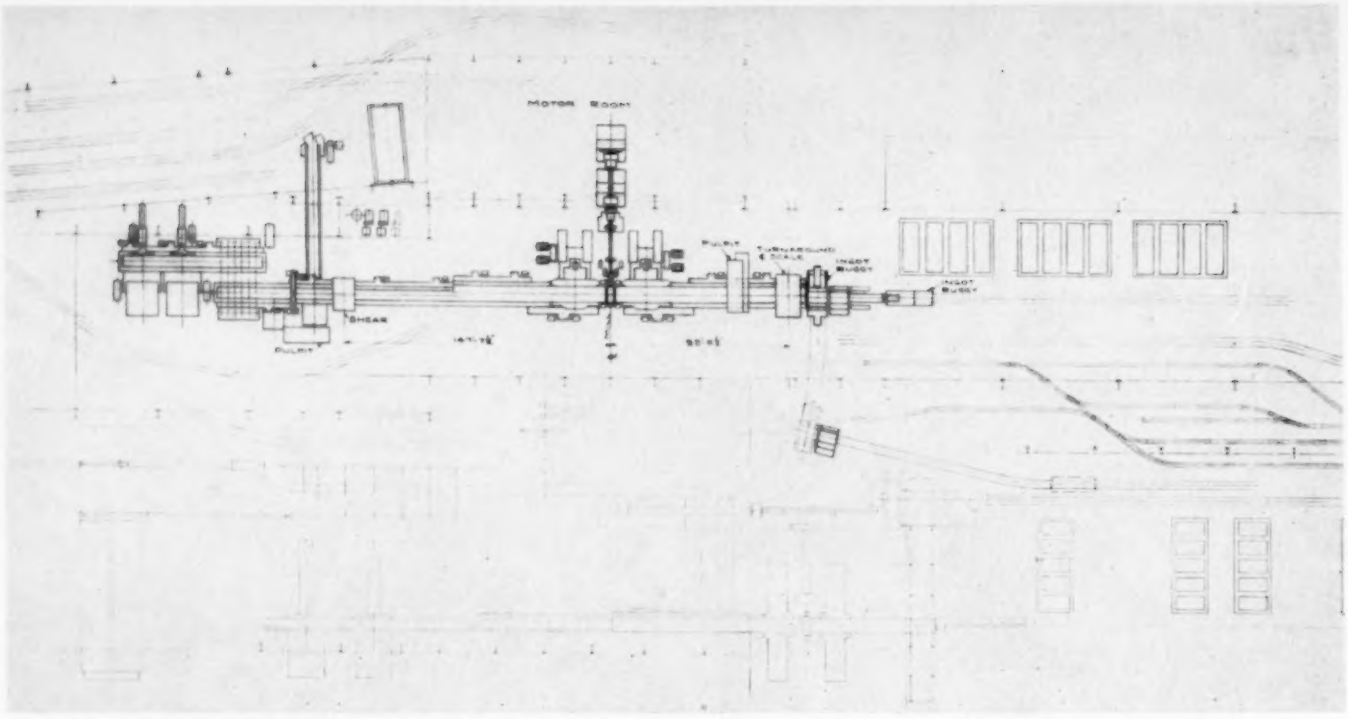


Figure 1 — General plan of the 46-in. two-high reversing slabbing-blooming mill installed at Pittsburgh Works of the Jones and Laughlin Steel Corp.

common with the mill. This runway has a 100 ft 0 in. span; 45 ft 0 in. from ground to top of rail. For servicing these soaking pits, there are two 25-ton soaking pit charging cranes, of the crane hoist type, which are equipped with 25-ton auxiliary hoists for maintenance and service work. This type of crane was adopted in preference to the old conventional counterbalance type formerly used. The operator's cab is located under the bridge girders and is a part of the trolley. Due to proximity of the cab to the pits, when drawing or charging ingots, cabs were air conditioned.

The soaking pits consist of twelve single burner, one-way fired recuperative pits, 27 ft 0 in. × 9 ft 6 in. × 14 ft 0 in. Each pit will cover 125 tons of ingots or the equivalent of one-half an open hearth heat. An 18-in. coke breeze bottom is maintained in the pits and breeze is added periodically between bottom cleanings. Bottom life to date has been approximately 30 days. Hearth area is 256.5 sq ft per pit or a total for the 12 pits of 3078 sq ft.

The twelve pits will hold a charge of 1500 tons of ingots. The twelve pits are in line parallel with the ingot track which makes for more pit hearth area available in same overall space. This arrangement facilitates faster charging and drawing of ingots. Each pit has its own trolley type cover carriage which makes the installation more flexible. Pits are so coupled that they operate in three banks of four pits each, with one tile, one metallic recuperator, and one stack for each bank of four pits. This system of recuperation raises the combustion air temperature to approximately 1200 F.

Fuel for pits is by-product gas for normal operations, and for emergencies liquid fuels (tar or fuel oil may be used). Fuel-air ratio for combustion is accomplished by modern controls with gas to air operation which makes for safety and accuracy. The burner is of multiple tube design which has given very satisfactory results.

Bottoms are made in the following manner: Two trap doors are located in bottom of each pit. Pallet type ash boxes are placed under each tapping hole previous to making bottom. After holes are opened, a charging crane, equipped with a detachable scraper, moves ashes in bottom of pit to the clean-out holes. After a pit is properly cleaned, holes are closed and coke breeze is put in the pits by means of a cylindrical container that has a funnel type bottom. This method permits the crane operator to spread the breeze evenly over entire bottom. The entire operation consumes about one to one and one-half hours.

Average track time of ingots is approximately two hours, with pit time dependent upon the individual track time of each heat. Careful observation has shown that ingots in these pits are heated uniformly as they progress from the charging temperature to finish, or "ready to draw" temperature. There has been no problem with cold sides or butts. In early design stages, there was concern that a full charge of ingots in pits of this size could not be drawn consecutively; but that possibly only half a charge might be drawn at one time due to temperature drop of ingots in back portion of pits. However, the opposite condition has been our experience. Ingots are heated uniformly throughout the pit so that entire charge is drawn, from front to rear, until pit is empty. Liquid fuel has been tried with satisfactory results. Inasmuch as these pits have been in operation only since August 1952, complete performance figures are not available, but our best month to date has been 137,000 ingot tons, and best 24 hour period 6028 tons ingots heated. Current average fuel rates to date are 430,000 Btu per net ton.

When ingots are drawn, they are placed in a remote controlled, electrically operated pot car which runs over a structural steel trestle to the ingot receiving table. The use of such a trestle allows scale to fall beneath

track thereby eliminating the necessity of a shutdown for scale removal. This type of installation also eliminates the potential hazard to workmen when cleaning area which otherwise would be necessary on surface ingot tracks. During repair turns, it is also necessary to check equipment which would interfere with cleanup work resulting in the possibility of delay later during the week. Another reason, if an ingot is dropped on the trestle, structural repairs can be made faster and operations quickly restored, whereas if an ingot is dropped on a concrete supporting structure, a major repair job usually develops.

The ingot pot of the car is cam operated for tilting, i.e., the crank arms of the pot enter tilting slides, which tip the pot as it moves ahead, thereby eliminating electrical and mechanical tilting devices.

As mentioned previously, ingots can be delivered from either of two soaking pit buildings. When coming from the older pit installation which is not in line with the new mill, a section of the ingot receiving table moves to the adjacent pit building and operates as an ingot transfer. Such transfer table is equipped with electrical interlocks that prevents ingots from accidently being rolled off the table. This traveling section of table has a speed of 402 fpm to insure no delay in getting ingots to the new mill.

After ingots are delivered to approach table from either pits, they are turned 180 degrees if necessary for bottom first rolling, weighed and recorded, and when desired, weights are totaled. By this arrangement, there is a positive weight of each ingot, heat, and day's production available. The scales are checked once every eight hours with test weights. The scale operation is semi-automatic, being started by the operator, and the rest of the operation following automatically in proper sequence.

After weighing, further movement of the ingot is taken over by the roller. We should note here, because of its extreme importance, that main mill tables, manipulators, screwdown, and both ingot buggies are controlled by variable voltage equipment. We believe this is important due to flexibility and speed of operation, which is a large factor in high tonnage rates and last but not least, less severe on equipment thereby reducing breakdowns and extending life of machinery, all of which decreases maintenance costs.

The mill approach tables are 110 in. wide. This provision was made for several reasons:

1. To turn ingot of 100 in.
2. Occasionally, ingots upset and considerable trouble is usually experienced in removing them from narrow tables. In our case, with wide tables, ingot can be moved to manipulator and edged without loss of time.
3. Allows for longer lengths of blooms and slabs when using passes on each end of roll.

The main mill tables are of heavy construction. They are 42 ft 6 in. long; 110 in. roller body, 20 in. in diameter; and with roller necks 9½ in. in diameter, equipped with anti-friction bearings. The table rollers are designed with cartridge bearings, in order that a defective table roller can be removed and replaced by loosening only a few bolts. The lineshaft also is of heavy construction with anti-friction bearings for load and thrust. Lubrication of the various mill tables, which is duplicated on all tables of the mill, is by means of an automatic grease system connected to all roller bearings, gears and gear drives. At some time in the future it will be necessary to make emergency repairs to main mill table rollers that are located under the manipulator heads. For this reason, the manipulators are so constructed that when the need presents itself, the manipulator heads can be moved clear of the rollers, thus saving valuable time by permitting the changing or repairing of rollers without removing the heads from the manipulator.

Acceleration and deceleration of main mill tables is extremely fast; an important factor in high production. Each main mill table is driven by two 200-hp motors which permit the tables to reach a surface speed of 267.5 fpm.

MILL HOUSING, SPINDLES AND MOTORS

We will touch lightly on mill drives, as the next paper in this issue covers this highly interesting, important

Figure 2 — A motor driven pot-type ingot buggy, ingot receiving table, and roller-type ingot transfer buggy are used for handling ingots.

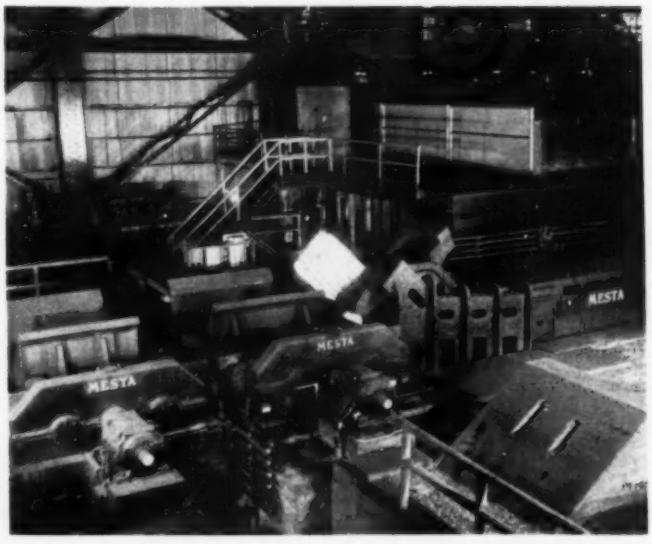


Figure 3 — Motor driven roller-type ingot transfer buggy enables the mill to get ingots from two soaking pit buildings.

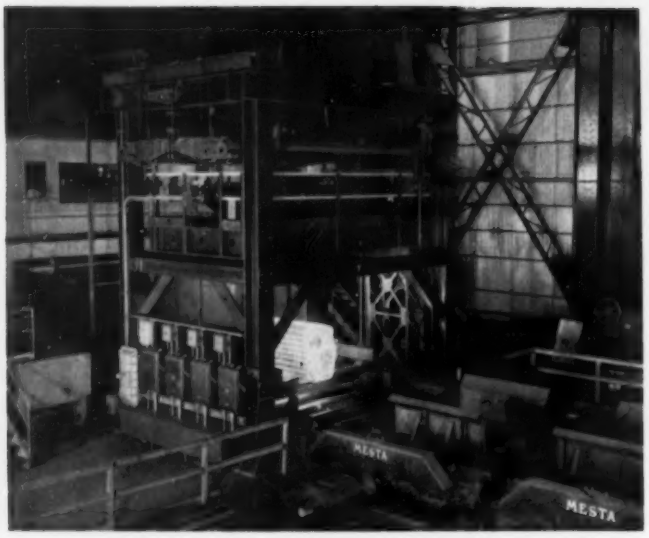


Figure 4 — Overhead ingot turnaround and ingot scale. Scale operation is semi-automatic.

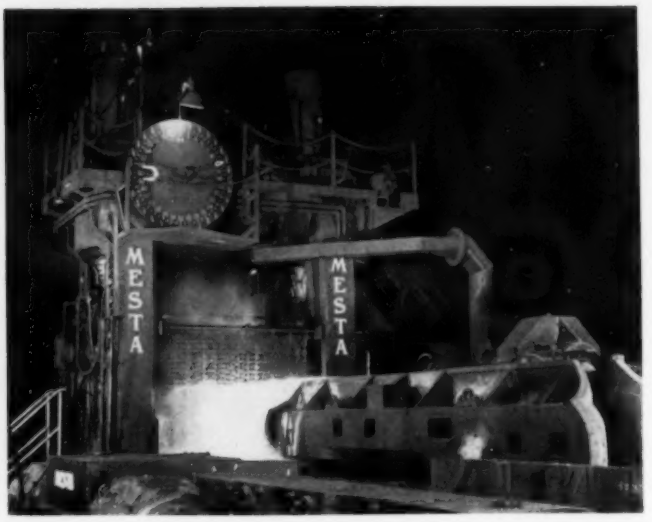


Figure 5 — The 46-in. two-high reversing slabbing-blooming mill with manipulators and tables.

and complex portion of the mill. The mill is driven by twin 5000-hp motors of 40-85 rpm speed with reversal time of one second base to base speed. The mill motor drive and auxiliary equipment is housed in an air conditioned motor room with 60 per cent of air being recirculated through spun glass filters and 40 per cent new air which passes through an electrostatic precipitator. From the motors the rolls are driven by spindles 34 ft 3 in. long. This length was determined by the height to which the top roll is raised and the relative location of the drive motors and the mill. The inclined angle is 6.25 per cent and declined angle 1.17 per cent.

Mill housings are designed for roll opening of 66 in. with new roll collar size of 45 in. diameter. With roll opening designed at 66 in. there is actually an extreme opening of 68 in., not for rolling purposes, but as a safety factor for overtravel of screws. The rolls are 45 in. collar diameter, 114 in. body length, neck 27 in. diameter, 28 in. long and used with babbitt type bearings.

The screws are 2½ pitch, 16 in. diameter, driven by two 200-hp 230-volt, shunt-wound, mill type motors through worm reducers. Power for these screw down motors is supplied through a variable voltage motor-generator set, generating a maximum potential of 600 volts. Through the use of variable voltage control equipment, screw speeds of 645 rpm are attained. At time of writing this is believed to be the fastest screw down drive in existence. It is also unique in its ease of operation and "spotting" characteristics. This is of utmost importance where ingots of wide width are slabbed on a high lift mill.

Housing screws are of hardened steel and work in a bronze screw box. With the high speed of screw travel, the rubbing speed may necessitate the development of another grade of screw and nut, however, time and tonnage will be the determining factor.

Feed rollers are located in the mill housings and are equipped with anti-friction bearings. In order to reduce wear to mill housing, hardened sleeves are expanded in the housing. The feed rollers are independently driven. Roll balance is of counter-weighted type.

Conventional application of water is used on the rolls for cooling of roll body and roll necks, and of course serves the dual purpose of flushing scale. There are three roll sprays over the top roll and three under the bottom roll.

Figure 6 — The 2500-ton hydraulic slab and bloom shear is of the up-cut type.

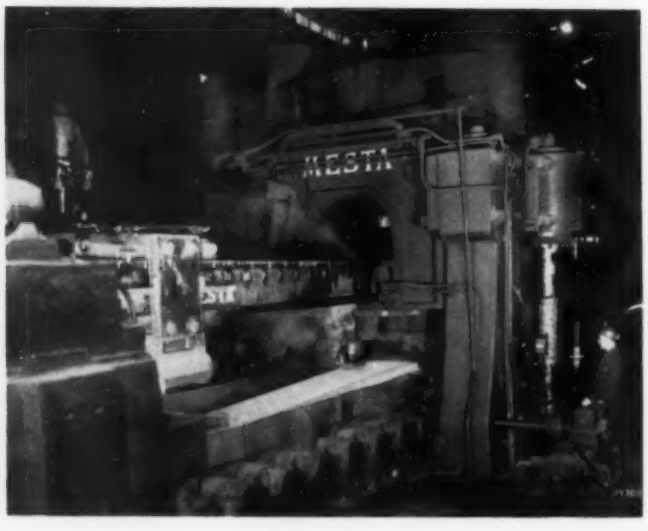


Figure 7 — Slab pilers, tables and slab transfers are designed to keep mill rolling without delays.

Rolls are designed with three edging passes — 8⅝ in., 5⅝ in., and 13 in.; and one slab pass.

There are approximately six sizes of ingots rolled, the most common being 27 × 36, 25 × 47, 27 × 43, 27 × 52, and 27 × 66 in., weighing from 17,200 to 34,600 lb.

All the various grades, common to the slab trade are produced on this mill. Also with the present roll design, blooms can be rolled if required. Mill and rolls are so designed that if necessary at any future date, the mill can roll blooms 7 × 7 in. and larger.

In any mill of the high lift type, manipulation of the ingot is of great importance. The manipulator in this mill is probably the fastest built to date. Sideguards have an ultimate travel speed of 158 fpm and here again, variable voltage control is used for fast operation. One of the fine points is the speed and ease with which the manipulator fingers turns the ingot or slab, especially those in the wide ranges. Provisions have been made for fingers on both the entry and delivery side of the mill. At this time, however, only the fingers on the entry side of the mill are used.

As the slab or product moves from the roll stand it passes under a radiation pyrometer which measures and records the finish temperature. This temperature reading is taken from the top side of the slab.

The product shear is the up-cut type, hydraulically operated. The throat opening is 24 in. and shear blades are 72 in. long. Shears were designed to cut up to a cross sectional area of 800 sq in. The reason for such a large shear was due to the possibility of "double converting" of ingots. Pressure to operate this shear is generated by two pumps, each capable of 2500 psi pressure at 205 gpm. In order to reduce the suction head or supply to pumps, a small vertical single stage centrifugal pump is used. All used water returns to a sump thereby making this a closed system. A small amount of soluble oil or equivalent is added to the water. The travel of the knife is adjustable in order that any length of stroke can be made thus reducing the load on the pumps and saving of time in shearing. When cutting 6-in. slabs, the shear is capable of five strokes per minute. Being an up-cut shear, no depressing table is necessary but a drop table is installed on the delivery side of shears to allow for crop disposal.

As the crop ends drop from the shear knives, they fall through chutes into a crop conveyor which delivers them to the outside of the building, into scrap cars. As cars are filled, they slowly move past the conveyor and when one car is filled another car is pulled under the conveyor. The conveyor is a conventional paddle or flight type operating at a speed of 36 fpm, traveling a distance of 80 ft.

The shear gage will measure product up to 21 ft 0 in. The shear gage is moved by a single 12-in. screw driven by a 50-hp motor through a worm gear. The speed of the screw is 16 fpm which is necessary to set the gage for various lengths at high speed rate of shearing. The vertical lift of the gage is also electrically driven.

Immediately following the shear is a slab or product scale. It is desired to weigh as much product as possible. The scale weighing cycle is approximately 12 seconds. With the exception of extremely short cutting (5 - 6 cuts per ingot) all product can be weighed. After the product has been moved onto the scale, the weighing cycle is manually started with the balance of the weighing operation automatically following in proper sequence. The scale levers and drives are under the tables with the electronic recorder located in the shear recorder's pulpit. Weights are not only recorded but are totaled in same fashion as at the ingot scale.

To reduce the stock of spares, both ingot and product scales and equipment were duplicated as much as possible.

The delivery end of the mill is made up of two pushers, two pilers and two slab pile "drag offs."

The pushers which are of the rack and pinion type, transfer the slabs from the runout tables to the pilers. These pilers are of the elevator type which are moved by two worm driven screws installed beneath each piler. As the slabs are pushed off the tables on to the pilers they become "stacked." Piles can be made to 48 in. in height. Number of slabs per pile of course depends on the thickness of each slab. The piler and auxiliary equipment will handle any length slab up to and including 20 ft 0 in. After a pile is complete, piler is lowered and the pile is dragged off so that another pile can be started. The drag-off can accommodate from four to six piles depending on width of slabs. In the case of short slabs two piles can be made on each piler and of course double the piles can be on the drag off skids. This is beneficial if for any reason cranes get behind, the mill need not stop rolling.

From the piler, product is moved by crane, equipped with rotating "C Hooks," either to rack cars, stocking area, or to the conditioning yard.

All through the design of this mill it was planned to duplicate as many pieces of equipment as possible. Accessibility for maintenance was also closely checked so that when failures developed, replacement could be made with shortest possible down time and with as few men as possible. All through the design stage, operating and maintenance personnel expressed their desires. All sections of mill were checked so that failures, experienced in the past, could be reduced or eliminated.

DISCUSSION

PRESENTED BY

T. M. FAIRCHILD, Assistant to General Manager, Bethlehem Steel Co., Johnstown, Pa.

A. C. GRAY, Superintendent, Bloom, Billet and Conditioning, Steel Co. of Canada, Ltd., Hamilton, Ontario, Canada.

J. H. MAYER, Assistant Superintendent, Blooming Mill Dept., Jones and Laughlin Steel Corp., Pittsburgh, Pa.

LOUIS MOSES, Mill Engineer, Bethlehem Steel Co., Bethlehem, Pa.

E. C. PETERSON, Engineer, Birdsboro Steel Foundry and Machine Co., Birdsboro, Pa.

FRANK CZARNIECKI, Open Hearth Dept., Steel Div., Ford Motor Co., Dearborn, Mich.

T. M. Fairchild: Nothing was said concerning the handling of scale from this mill and I think it might be of interest if Mr. Mayer would tell us how it is accumulated and handled.

J. H. Mayer: Inasmuch as the ingot delivery buggy

is operated over a trestle, it permits scale from ingots to fall through to the lower level. Along the foundation wall, and in line with the mill tables, is a trough. When necessary, the "drag line" scoop is moved along this trough pulling the accumulated scale to the water flushed sluice under the mill tables. This scale plus the pit scale is then flushed to a large scale pit adjacent to the mill building. Scale is removed from the pit when necessary by a 1½-yd grab bucket and loaded into hopper cars.

The "drag line" mentioned is powered by a double drum, electrically driven piece of equipment made for such applications.

A. C. Gray: Would Mr. Mayer answer the following questions?

1. What is the number of turns worked per month to get the tonnage you speak of — 137,000 net tons?
2. What overall increase in tonnage might be expected when you put your mill auxiliary equipment on variable voltage control?
3. Have you experienced with your large soaking pit capacity an edge condition consisting of a streak along the edge of the slabs rolled which penetrates into the body of the slab and leads to a lamination in the course of rolling to plate?

J. H. Mayer: The answers are as follows:

1. Ingot tonnage of 137,000 tons heated was accomplished in 85 turns.
2. All necessary equipment was initially equipped with variable voltage control and no further additions are contemplated.
3. To date, we have had no edge condition problem with slabs produced from our pit facilities.

Louis Moses: Regarding pits in general, it is not always accurate to state capacities as so many tons of ingots heated per month. A highly efficient pit installation can be handicapped through the relatively slower operating rates of an inefficient mill. The reverse of this occurs when high mill rates are possible but which are slowed down by low heating rates at the pits. It appears from the description that pits and mill are pretty much in balance, but would Mr. Mayer tell us the average size of ingots heated and how many are in the pits. What is the firing rate in terms of Btu per hour? In regard to the burners, can we learn what alloy is used in their composition and what life is obtained.

The screw speed of 645 ipm appears to be very fast. Does roll jamming ever occur, and if so, what method is used to release the rolls? A final request would be for further comments on the roll balance.

J. H. Mayer: These soaking pits were designed to take one-half the total number of ingots made in one heat, which is approximately 125 tons per pit. Your question as to the average size of ingots heated is not clear. However, the sizes of ingots regularly used are: 27 × 36 in., 25 × 47 in., 27 × 43 in., 27 × 52 in. and 27 × 66 in. Since start of operation on new pits our fuel rate has averaged 430,000 Btu per net ton ingots heated.

To date, we have experienced no trouble with multiple tube burners in the soaking pits and see no deterioration. We are unable to estimate expected life of burners at this time. Burner tubes are fabricated from 2512 alloy.

We have jammed our screws three times to date, however, we have had no trouble releasing the rolls. We have not as yet considered equipping the mill with an "unjamming" device, but a practical one can be purchased if necessary in the future.

The counter weighted roll balance to date has presented no problems. We believe (this being our first application) we prefer this type over hydraulic. It certainly relieves a congested area and reduces maintenance cost. It also eliminates some delays usually encountered from packing failures.

E. C. Peterson: I am interested in knowing how the water is piped to the rolls.

J. H. Mayer: Top rolls have three pipes, one exactly in the center, and one 10-in. on each side of the center. These are scoop type jets. This adds pressure to the spray and evenly distributes the water over the entire roll. Roll cooling on bottom rolls is done in same fashion except that slotted holes in the pipes are used instead of the scoop jets. Water is delivered at 30 psi. Twin strainers are provided in the sprays to prevent dirt from going through.

Frank Czarniecki: I am interested in the up-cut shear. Is that water pressure, oil, or hydraulic oil pressure? We have some trouble moving scale now and then as the scale from our 44-in. mill is moved through a sluiceway 650 ft long into a scale pit. I was wondering if you have different means beside scale pits for moving that amount of scale. I am also interested in the slab shear blades. I was wondering whether you have any difficulty when shearing a square cut, and are the slabs flat or are the slabs curved up. I am also interested in drag off skids at the piler. Also what is the speed of the screws on your 46-in. mill?

J. H. Mayer: Your question regarding scale handling has been answered in my remarks to Mr. Fairchild.

Our "up-cut" shear is powered by water, hydraulic pressure up to 2500 psi.

I do not understand why you should encounter any trouble moving scale in your sluice. The distance you move your scale (650 ft) seems a little far, however, if the drop is sufficient and the volume of water high enough, scale should be moved satisfactorily.

Shear blades are made from rolled slabs with a "hard face," welded on one cutting edge only, applied electrically. To date, our service has been good, with cost below a tool steel blade.

The original installation of our shears included a hold down gag which presented so much difficulty it was removed. We installed a stationary gag that prevents the cut portion of the slab from "kicking" up in the air and also minimizes the bend in the end of the slab.

The so-called "drag off" is not a new idea and consists of a set of skids adjacent to the pilers. As the pile of slags is completed, the piler is lowered until it rests on a set of arms or racks that pulls the pile from the piler to the adjacent skid bars thus permitting the piler to be used again without waiting for the crane. Several piles can thus be made without causing delay to mill operations.

The mill screwdown with its high speed has not presented a problem. The screws operate in a bronze screw block or nut. This design is not unusual to conventional design.

ELECTRICAL DESIGN AND OPERATION OF A MODERN 46-IN. HIGH LIFT SLABBING-BLOOMING MILL

By GEORGE A. KAUFMAN
Chief Electrical Engineer
Jones & Laughlin Steel Corp.
Pittsburgh, Pa.

and

ANDREW W. SMITH
Steel Mill Engineer
Westinghouse Electric Corp.
East Pittsburgh, Pa.

. . . . unusually fast response and more than average field forcing are features of this new high-lift blooming mill . . . .

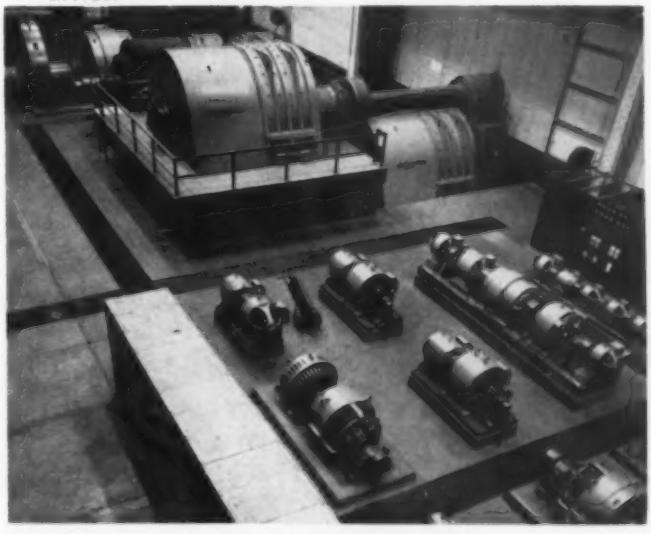
▲ THE new 46-in. high lift blooming-slabbing mill at the South Side plant, Pittsburgh works of the Jones and Laughlin Steel Corp. is an important part of the J & L expansion program. It replaces a 44-in. steam driven mill that had operated since 1927. The new mill must take a large part of the steel coming from the new open hearths at the South Side plant. It is driven by fast operating electric drives for high production. The main and auxiliary drives give rapid speed changes without making the mill hard to operate because they are coordinated to work together. A comprehensive system of spare and emergency equipment minimizes down-time.

MAIN DRIVE

The 10,000-hp twin motor drive consists of two 5000-hp, 40/100-rpm, 700-volt, single armature, direct-current, reversing motors; each arranged to directly drive a mill roll. Figure 1 is a photograph of the main motor with the main exciter set and several two-unit auxiliary motor-generator sets shown in the foreground. This 10,000-hp twin motor has a rated full load torque of 1,312,000 pound-feet at speeds up to 40 rpm, and a maximum emergency torque capacity of 275 per cent of rated torque or 3,610,000 pound-feet. Since the mill is now rolling only slabs, the motor is adjusted to operate up to 80 rpm. If the mill is used to roll blooms, the control can be set to operate up to 100 rpm.

Direct-current power for the main reversing motors is supplied by a six-unit flywheel motor-generator set

Figure 1 — View of motor room shows the 10,000-hp twin drive motor, five-unit main exciter set, rotating regulator set, and main drive control. The two-unit sets in the foreground are for the variable voltage auxiliary drives.



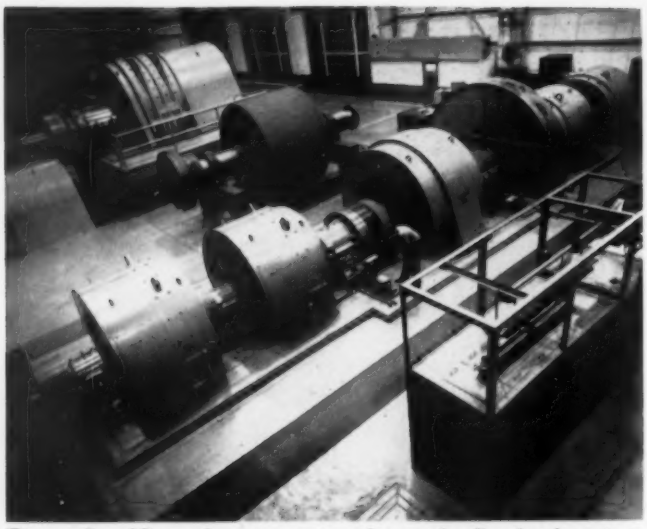


Figure 2 — View of motor room shows the flywheel motor-generator set, the main drive motor, and the spare armature for the main drive motor. The liquid slip regulator in the right foreground is connected to the slip rings of the 8000-hp wound rotor driving motor on the flywheel set.

consisting of four 2500-kw, 700-volt, 505-rpm, direct-current generators; an 8000-hp, 13,800-volt, 3-phase, 60-cycle, 514-rpm synchronous speed, wound rotor induction motor; and a steel plate flywheel which is 14 ft in diameter and weighs 125,000 lb. A photograph of this motor-generator set is shown in Figure 2. When running at synchronous speed, all of the rotating parts of the flywheel motor-generator set have a stored energy of approximately 290,000 hp-seconds.

The four 2500-kw generators and the two 5000-hp reversing motors are all connected in parallel on a common bus with the circuits arranged so that any one of the generators can be taken out of service without interrupting the operation of the mill. Since a mill of this

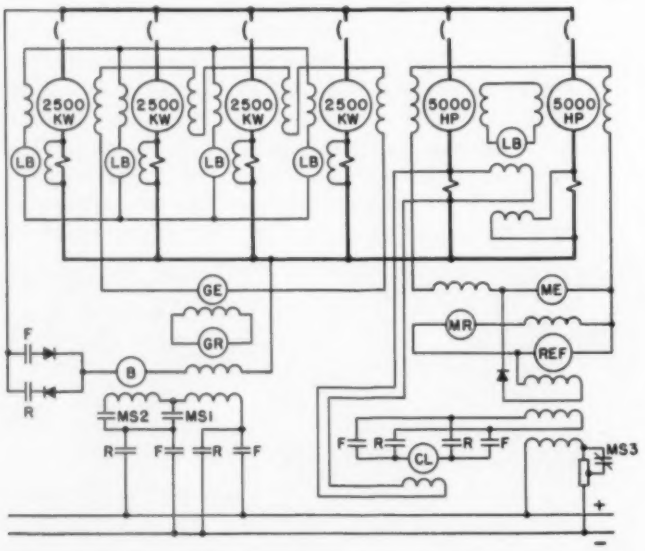


Figure 3 — Simplified control diagram of blooming mill main drive.

size would normally use three 3000-kw or four 2000-kw generators, the four 2500-kw machines make it possible to run the mill with one generator out of service with no noticeable reduction in capacity. Any one of the generator armatures can be removed from the motor-generator set. Either of the inside armatures would be replaced by a dummy shaft so that the three remaining generators could be operated.

The 2500-kw machines have laminated field frames to allow the commutating pole flux to closely follow the changes in load current, thus greatly improving the commutation under rapidly changing load conditions. This also increases the speed of response of these machines.

Low speed reversing motors with solid frames normally give very good commutation but, in order to obtain the maximum possible speed of response along with the best commutation performance, the two 5000-hp reversing motors are constructed with laminated field frames.

Figure 3 shows a simplified control diagram for the main drive motors and generators. A rotating regulator is used to make the two 5000-hp motors share the load equally. Each generator includes a load balance field which is connected in series with a load balance rotating regulator. The load balance regulator control field is connected across the generator commutating and compensating windings. The four load balance regulators and generator fields are connected in parallel. When the currents in the four generators are equal, the voltages across the four load balance regulators are

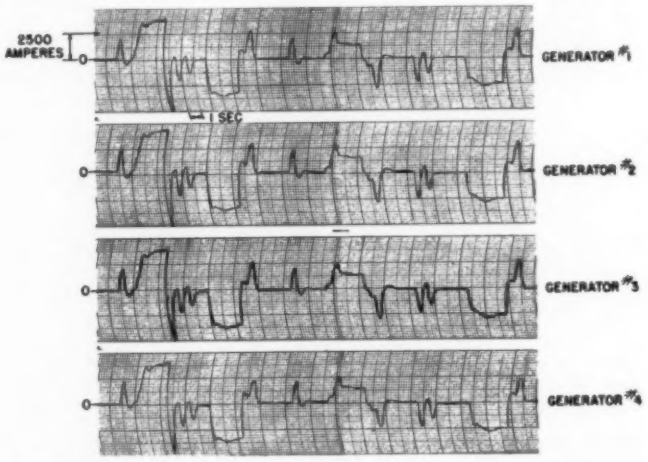


Figure 4 — Oscillogram of loads on four 2500-kw, 700-volt, 3570-ampere generators show good division of load with fast changing currents as well as steady currents

equal and no current circulates in the generator auxiliary fields. Whenever one generator tends to take more than its share of the load, the voltage on its load balance regulator is larger than the voltage of the three other regulators. This difference in voltage circulates current through the generator load balance field in such a direction to reduce the load. The current then divides three ways and one-third passes through each of the other generator load balance fields to increase the load on these generators.

This generator load balance scheme is particularly suitable because one of the generators can be taken out of service without disturbing the load balance on the remaining generators simply by disconnecting the unused rotating regulator.

Figure 4 is an oscillogram of the four generator load currents which shows that this load balance system does an excellent job with fast changing loads as well as steady loads.

The generator voltage regulator consists of an exciter, a rotating regulator, and a bias exciter. The generator voltage is measured by the regulator voltage field and compared to the pattern field, which is under control from the operator's master switch. The exciter and the regulator deliver high forcing voltages to change the generator voltage rapidly. The bias exciter prevents any current from flowing in the regulator voltage field until the generator voltage exceeds the bias voltage, thus maintaining the high forcing as long as possible without producing any appreciable overshoot.

The motor field regulator consists of an exciter, a rotating regulator, and a reference machine. The regulator voltage is proportional to motor field current since its current field is connected in series with the exciter. The voltage of the reference machine is set by the master switch. The difference between these voltages appears across the exciter field and forces the motor field current to make the two voltages approximately equal. The motor is always operated at full field except when the master switch is on the third point.

A current limit rotating regulator excites a field of the reference machine. This regulator limits the motor current during rapid changes in motor speed between 40 and 80 rpm, and also it limits the rolling load to a safe value. Whenever the reversing motors are operated above 40 rpm and the rolling load is too high, the current limit regulator strengthens the motor field to obtain a higher torque from the reversing motor. The current limit is so effective with this fast regulating system that the breakers seldom trip on overloads.

The worst regenerative currents occur when the motor field regulator begins to reduce mill speed by strengthening the motor field because the torque per ampere is relatively low at weak field and the stored energy in the mill and motor is at a maximum. To obtain approximately the same regenerative current throughout the decelerating cycle, a modifying field on the reference machine is connected to read the difference between the reference voltage and the motor exciter voltage. During transient conditions, the reference voltage is higher than the exciter voltage, thus causing current to flow in the modifying field which reduces the rate at which the motor field can be strengthened. A rectox is connected in series with the modifying field to prevent it from operating when the motor fields are being weakened to accelerate the mill.

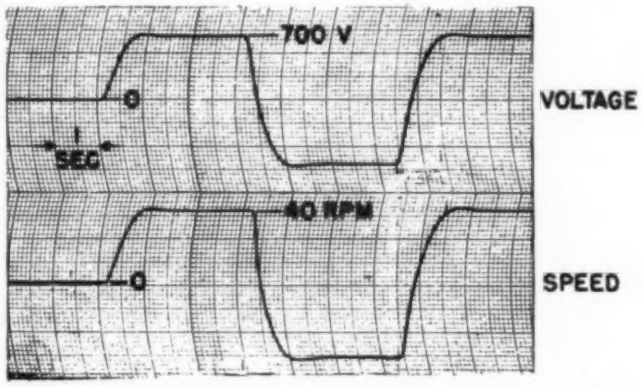


Figure 5 — Oscillogram of main drive motor speed and voltage shows a reversal from 40 rpm to 40 rpm in one second; a faster reversal than has been obtained on any previous mill.

This regulating system makes it possible to change the mill speed quickly. Figure 5 is an oscillogram which shows that the mill reverses from 40 rpm in the forward direction to 40 rpm in the reverse direction in one second. This is a faster reversal than has been obtained on any previous electrically driven reversing mill. The mill reverses from 80 rpm to 80 rpm in approximately three seconds. This is also a good record because the motor torque at the higher speeds is relatively low.

In order to obtain such fast speed changes, it is necessary to use high forcing voltages on the generator fields and the motor fields. This means that the generator and motor exciters become quite large. For example, the generator fields are connected in series and require approximately 60 volts to circulate the proper amount of current to obtain 700 volts on the generators. The steady-state load on the generator exciter is approximately 10 kw. During transient conditions, the generator exciter voltage reaches 600 volts (ten times normal) in order to change the generator field strength rapidly. The generator exciter therefore had to be built on a frame which would normally have a 100-kw rating in order to obtain the forcing voltage. Since the forcing voltage on the motor fields reaches five times normal, the motor exciter frame corresponds to a 225-kw rating even though the power for field excitation is only about 45 kw.

This fast reversal assures the operator that the mill changes directions between passes rapidly enough to be up to speed before the tables can return the ingot to mill thus eliminating any delay in production. The rate at which the mill decelerates helps the operator to handle slabs that develop "split ends." When the operator sees a split end coming out of the mill, he can reverse the mill and then re-enter the slab. As the slab backs out the mill, the split end is closed and, since the reduction has already been made on the end of the slab, the split does not reopen when it is entered again. The mills with longer reversal times may have difficulty in stopping the slab soon enough to keep the split ends from jamming in between the feed rolls or table rolls.

AUXILIARY DRIVES

High production depends to a large extent on the mill auxiliary equipment. About 70 per cent of the production time is used in auxiliary operations, such as changing the screwdown settings, positioning and turning the ingot, and bringing the ingot back to the mill on the tables and feed rolls. Variable voltage drives are used for all of the auxiliaries which are closely associated with the mill in order to keep the ingot handling time to a minimum.

Figure 6 shows the schematic arrangement of the variable voltage auxiliary drives. The front and back mill tables, the mill screwdowns, and the left and right manipulators are each driven by two 200 hp mill motors. Each of the four feed rolls is driven by a directly connected 150-hp, 230-volt mill motor which is operated at 40 volts to give a rating of 17 hp at 53 rpm. The front and back manipulator fingers are each driven by a 150-hp mill motor. The roller type ingot buggy and the pot type ingot buggy are driven by 100-hp mill motors.

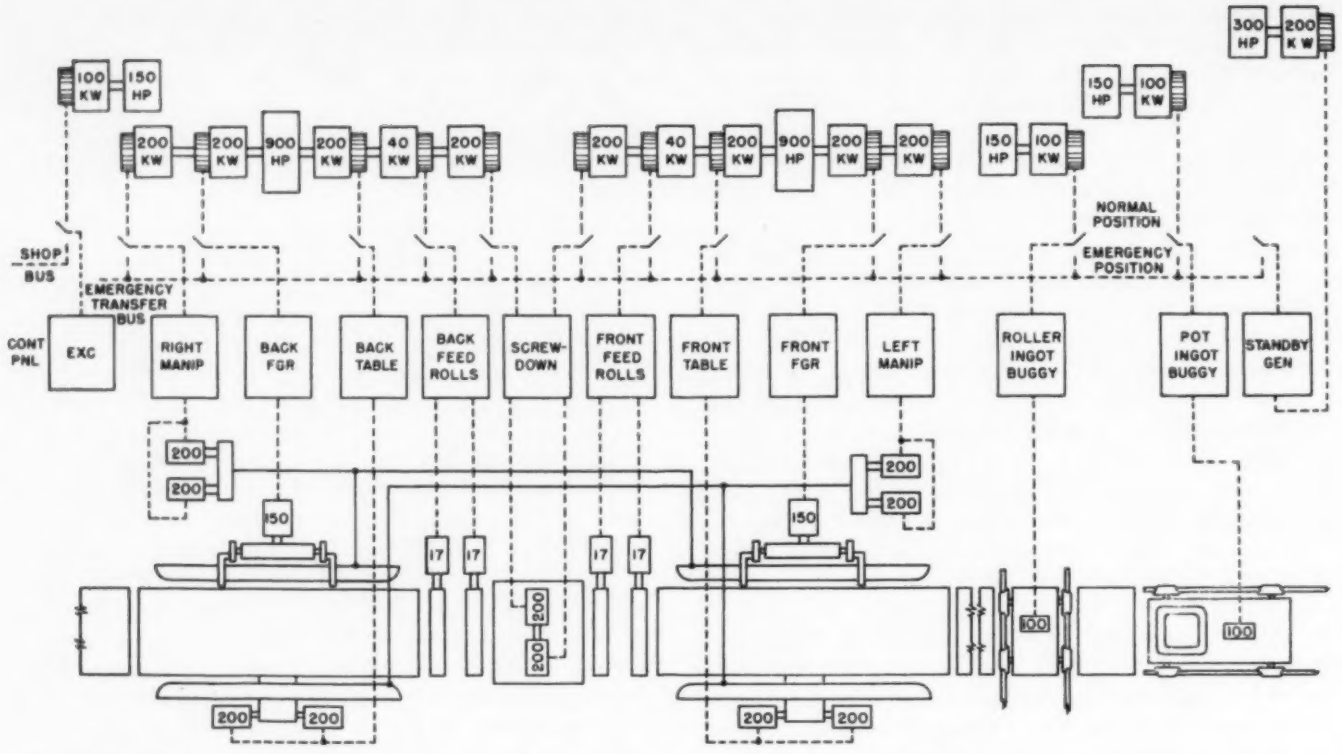


Figure 6 — Schematic arrangement of variable voltage auxiliary equipment shows the standby generator and the emergency transfer bus.

A two-unit motor-generator set with a 100-kw generator is used to feed each of the ingot buggy motors. The remaining variable voltage auxiliary generators are divided equally between two main motor-generator sets. A separate 100-kw, two-unit exciter set provides control and excitation power.

A stand-by generator which is duplicate of the 200-kw generators on the main motor-generator sets is driven by a 300-hp motor and a stand-by rotating regulator is used to excite it. The control for this stand-by generator is arranged so that, with a simple transfer switch arrangement, this generator can be used to take the place of any one of the variable voltage generators that is out of service. This stand-by generator is frequently used during the regular maintenance period so that the screwdowns or any one of the other auxiliary drives can be operated with one of the main motor-generator sets at stand-still for brush and commutator maintenance.

Whenever the 100-kw constant potential exciter is out of service, a transfer switch is used to switch over to the shop bus.

Figure 7 — View of motor room shows the main drive and variable voltage auxiliary control panels, the five-unit main drive exciter set, the six-unit and two-unit variable voltage auxiliary sets, and the rotating regulators for the main and auxiliary drives.

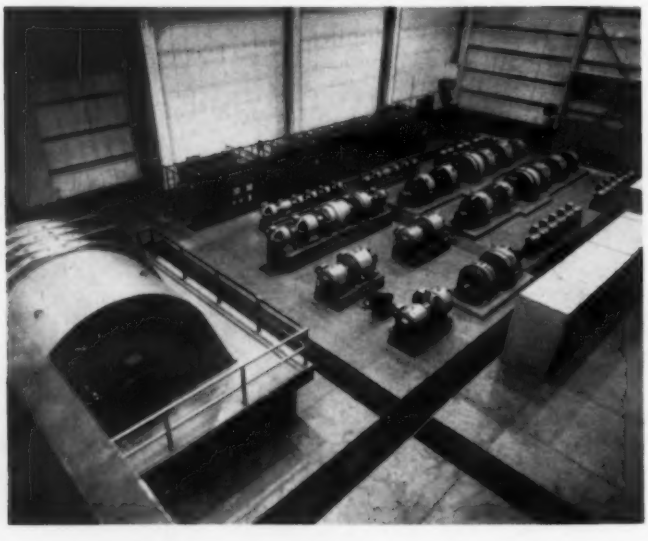


Figure 7 is a photograph of a part of the motor room which shows the two six-unit variable voltage auxiliary motor-generator sets. The two six-unit rotating regulator sets that provide the excitation for these generators are at the right. The four two-unit sets in the foreground are the standby set, the two ingot buggy sets, and the constant potential exciter set.

Figure 8 is a tabulation of the variable voltage auxiliary gear ratios and speeds. At the bottom of this tabulation, the main armature connections for the auxiliary motors and generators are shown. The pairs of motors for the table and manipulator drives are each connected in series across a 200-kw generator. The two motors on the screwdown are connected in sandwich series with two 200-kw generators. The two feed roll motors on each side of the mill are connected in parallel across a 40-kw generator. The manipulator finger motors and the ingot buggy motors are each fed from an individual generator. Two 200-kw generators are used to feed the two 150-hp finger motors so that the number of generator ratings can be kept to a minimum.

The screwdown gear ratio and screw pitch were selected for high speed screw travel, but the desired

APPLICATION	DIMENSIONS	GEAR RATIO	SPEED AT		ELECTRICAL CONNECTION
			RATED GEN VOLTAGE	MAX GEN VOLTAGE	
LEFT OR RIGHT MANIPULATOR	50" HIGH 29' LONG	10:1 28-1/2 DIA PINION	157 FPM	409 FPM	①
FRONT OR BACK MILL TABLES	16-20" DIA X 110" LONG	4.27:1	257 FPM	670 FPM	①
FRONT OR BACK FEED ROLLS	2-20" DIA X 110" LONG	DIRECT	278 FPM	695 FPM	②
SCREWDOWNS	16" DIA WITH 2-1/2" PITCH	4-1/12:1	258 IN/MIN	673 IN/MIN	③
FRONT OR BACK FINGERS	3" 5-1/2" LIFT	25:1			④
POT INGOT BUGGY	136,000 POUNDS 33" DIA WHEELS	10.43:1	400 FPM	1050 FPM	⑤
ROLLER INGOT BUGGY	155,000 POUNDS 33" DIA WHEELS	10.43:1	400 FPM	1050 FPM	⑤

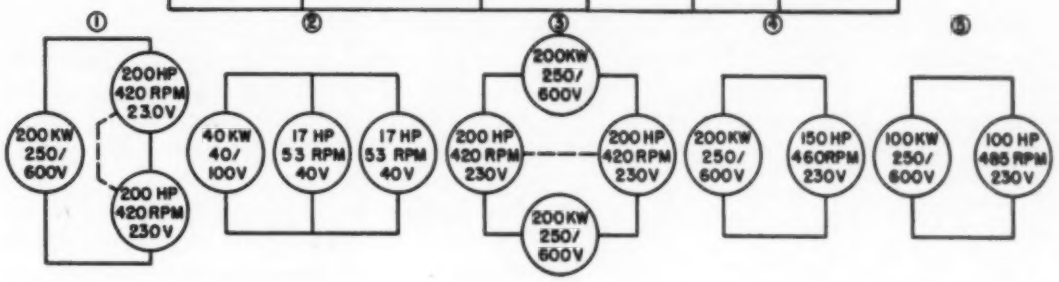


Figure 8 — Variable voltage auxiliary data is given for speed range with 42⅜-in. bullhead roll diameter, 40/80 rpm, 443/886 fpm.

screw speed of 600 inches per minute could not be obtained by this means alone. Variable voltage auxiliary generators are usually rated at 250 volts and are suitable for operating up to 500 volts at light loads. This would give a maximum speed of only 560 inches per minute at light load. In order to get a higher screw-down speed, these generators operate up to 600 volts. All of the other 250-volt generators are suitable for operation up to 600 volts, but most of the drives are set for some lower maximum voltage.

Figure 9 shows a schematic diagram of the control which is used for each of the auxiliary generators. A

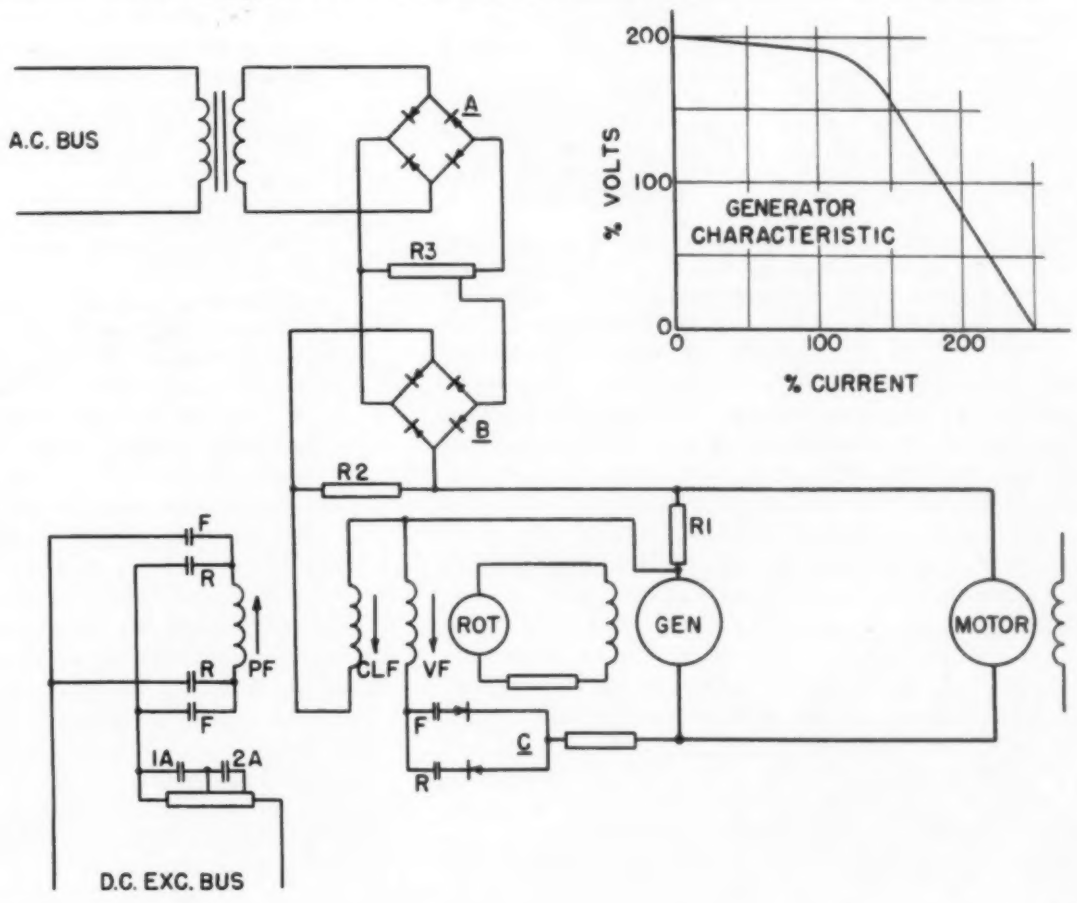


Figure 9 — Simplified control diagram for blooming mill auxiliary drives.

rotating regulator is provided for each generator and acts as a voltage regulator with current limit. The generator voltage is measured by the voltage field and compared to the pattern field, which is under direct control from the operator's master switch. The current limit field modifies the effect of the other two fields, thus reducing the generator voltage whenever the load current exceeds a fixed value of approximately 100 per cent. This arrangement reduces the voltage and stalls the drive at approximately 250 per cent of rated current, thus protecting the mechanical equipment as well as the electrical equipment.

A relatively fast regulating system is needed for this type of drive to get the most out of the equipment without exceeding the commutating limits of the machines. Liberal horsepower ratings were intentionally chosen for the variable voltage auxiliary drives to provide snappy operation. To utilize the available torque for accelerating and decelerating these drives, the regulating system must change the generator voltage fast enough to force the drives into current limit. All of the 200-kw generators have laminated field frames to give the maximum speed of response and to give the best commutation for the fast changing load currents that result.

Figure 10 shows oscillograms to illustrate how fast the auxiliary regulators operate. The oscillogram at the left shows the rotary regulator volts and generator

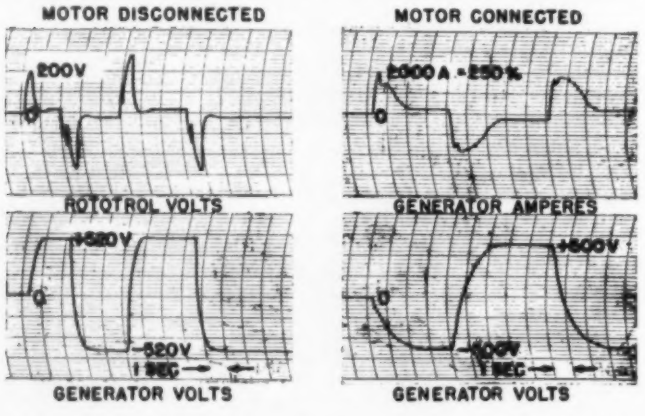


Figure 10 — Oscillograms show performance of mill table drive. The voltage reverses in well under a second with the motors disconnected. With the motors connected, the voltage changes fast enough to force the current to 225 per cent and reverses the tables in 2½ seconds.

volts as the regulator changes the generator voltage from zero to plus 520 and reverses the voltage from plus 520 to minus 520. This oscillogram was taken with the motor disconnected and is the type of response that would be obtained if it were possible to eliminate all inertia from the motor and the load. The oscillogram at the right shows the load current and the generator voltage as the regulator operates on the generator with the table motors connected. Notice that the voltage changes fast enough to force the peak load current up to approximately 225 per cent of rated and to reverse the mill tables from 560 fpm in one direction to 560 fpm in the other direction in approximately 2½ seconds.

The speed at which the variable voltage auxiliary drives respond to the operator's movement of the master switch makes it possible to easily control the positioning and turning of the ingot, and to reposition the screws quickly and accurately with easy spotting.

The rest of the mill auxiliaries are driven by d-c mill type motors that are fed through resistance type controllers from the shop bus. The constant voltage controllers are divided into three groups and mounted in control pulpits which are located along the motor room wall in the mill area. A spare controller is included in each of these groups and transfer switches are arranged so that this controller can take the place of any one of the table controllers. This arrangement makes it possible to carry the ingot from the ingot buggy to the mill and to carry the slabs from the mill to the piler even though one of the table controllers is out of order.

SUMMARY

All of this equipment works together to get steel through the mill from the ingot buggies to the piler with fast rolling and minimum delay. The main and auxiliary drives operate with speed and flexibility as they respond to the operator's master switch. This mill is inherently capable of high production with a minimum of electrical maintenance and down-time.

DISCUSSION

PRESENTED BY

ROLAND BANGERT, Electrical Engineer, Weirton Steel Co., Weirton, W. Va.

W. E. MILLER, Manager, Steel Mill Engineering, Industrial Engineering Section, General Electric Co., Schenectady, N. Y.

T. B. MONTGOMERY, Chief Engineer, Control Engineering, Hawley Works, Allis-Chalmers Manufacturing Co., West Allis, Wis.

ROBERT W. GRAHAM, Superintendent of Electrical Dept., Bethlehem Steel Co., Lackawanna, N. Y.

H. H. ANGEL, Electrical Engineer, Bethlehem Steel Co., Construction & Engineering Dept., Bethlehem, Pa.

A. W. SMITH, Steel Mill Engineer, Westinghouse Electric Corp., East Pittsburgh, Pa.

GEORGE KAUFMAN, Chief Electrical Engineer, Jones & Laughlin Steel Corp., Pittsburgh, Pa.

J. H. MAYER, Assistant Superintendent Blooming Mills, Jones & Laughlin Steel Corp., Pittsburgh, Pa.

J. D. O'ROARK, Assistant to Manager, Service & Maintenance, Weirton Steel Co., Weirton, W. Va.

Roland Bangert: Mr. Kaufman and his company also are to be commended for adding to this mill so many of these desirable, and in some cases, unique features, to make it a very responsive and reliable mill. As I see it, they have done two things to increase the response of this mill, particularly the main drive. First, they have gone to extreme lengths in field forcing and secondly, they have gone from solid field frames to laminated field frames on main drive motors and all exciters.

This, however, introduces an added initial cost to this mill, which is an important consideration to any steel company installing a mill of this type. I think the added cost of the larger frame size exciters required for this high degree of field forcing can readily be evaluated for any new installation, but I would like to ask this question: "What added cost is involved, percentage-wise, by going from the solid field frames to the laminated field frames?"

I would also like to know if Mr. Smith or Mr. Kaufman feels that the added initial cost of both the oversized exciters and the laminated field frames are justified, in the light of the increased response they get.

W. E. Miller: Just a year ago at the AISE Spring Conference in Cincinnati, the question was raised as to what is the optimum speed of reversal for a modern blooming and slabbing mill. I do not recall that any definite conclusions were reached except that we electrical manufacturers stood ready to supply whatever is required.

Extermely fast reversals do require somewhat special and more expensive equipment, for both the main drive and the auxiliaries. If the time of reversal of the main drive is short, then the manipulating, etc. should be done in less time, possibly meaning more horsepower and more excitation system power. The auxiliaries must keep up with the mill, and the interval between passes must approach the mill reversal time if increased production is to be achieved because of the fast reversal.

I note in the paper that particular reference is made to the laminating of the frames of the main generators, main motor and auxiliary generators. I also assume that the frames of the rotating regulators are laminated, but how about the generator exciter frame? Is it also laminated? Our experience indicates, that for such fast reversals, it is possible to obtain a substantial reduction in operating requirements for the rotating regulator if the generator exciter frame is laminated.

I did not note any mention of pulpit adjustment of no load speed balance or load balance between top and bottom motors. I understand that several plants operate with a larger roll in the bottom than in the top. Also, that some operators like to unbalance speed and load to control the turn-up of the front end of the slab as it comes out of the mill. Does the equipment described in the paper have such a provision? I also believe that any experiences pertaining to the ability to control the turn-up of the front end of the slab will also be of interest.

With reference to the charts showing generator line amps., it seemed to me that the initial load balance of the generators on the reversal peaks was possibly due to the inherent load balance characteristics of the generators, rather than the transient load balance characteristics of the regulating systems, because total current reversal occurred in somewhere between 0.1 and 0.2 of a second.

T. B. Montgomery: I think it is of very much interest to see the laminated frame extending into the auxiliaries, in line with our discussion at Cincinnati last year. I would like to add two thoughts to it. First, on the auxiliaries with current limit. I do not believe much comment was given to the speed of response of current limit. We have found this one of the control functions that demands careful attention in order to get a decrease in flux fast enough to stop current rise. More speed of response is required in current limit than in the rest of the control. The laminated frame, in both main exciters, and control exciters, we believe, is required. The second item is simplifying the control for the auxiliaries. I do not know where it has been used in the steel industry, but in other applications, in utilities, the armatures of machines of equivalent size have been tied directly together. The armature of the motors are tied directly to the generator.

The equipment has been running a number of years without contactor, circuit breaker or fuses. In a mill started up within the last sixty days, the current limit on variable voltage auxiliaries operates so fast the contactor in the armature circuit never has a chance to come out when a motor is stalled. Possibly to offset some of the cost of extra forcing and the laminated yokes, we can take out some equipment in the control like the main contactor to help offset the extra expense caused by feedback controls. As another item, I would like to ask the question, how long it took the mill to go into operation. On these new blooming mills, with the experience gained by the manufacturers, the speed with which the mill can be put into production from the start up time to full tonnage, or good tonnage, has become extremely short. It took about three days, on a mill recently installed, to produce 200 tons per hour.

R. W. Graham: I would like to ask three questions: First, in connection with the design of the feed rolls, I am wondering why we have the high voltage motor with low voltage on it, and why that design is applied. We are much interested in the feed rolls and we would like to have a little further discussion on why that particular design is used in feed rolls. The second question I would like to ask is, whether in this main mill reversal from 40 rpm to 40 rpm in one second, whether you made any extensive analysis of complete rolling cycle, whether the steel was always back and ready to roll in that time. In other words, the overall problem is whether we are making these reversing mills reverse so fast that we are getting more than we need, or do we need that fast reversal? Of course, with present controls, we can produce this fast reversal, but I am wondering if any studies have been made; on whether the steel is ready to get into the rolls, after reversing the mills in one second. The third question is on the design of the ingot buggies. The author spoke about two ingot buggies. I do not know how that would function. I would like to have that clarified.

H. H. Angel: In these days, while open hearth capacity is being increased, blooming mill soaking pit capacity is following the same trend, in order to assist in rolling the additional tonnage. Since the heating delays are being reduced, it is up to the blooming mills to take advantage of fast main drive and auxiliary reversing controls.

Recently I took some actual main drive rolling charts of several Bethlehem Steel Co. blooming mills having modern types of rotating regulator controls and calculated the change in rolling time of some slab products by arbitrarily changing the rate of acceleration and deceleration of the reversing motor. I found that by

changing the rate 10 per cent (it may not always be possible to speed up these rates due to increased currents and torques), the change in rolling time was almost 7 per cent for mills having fast auxiliary drives and 3 to 5 per cent for mills having slower auxiliaries or special problems in connection with the turning of slabs or entering them into the roll passes.

I have several questions that possibly Mr. Smith and Mr. Kaufman might be able to answer. Your screw down speeds are very high. Up to a short time ago, 35 fpm was regarded as quite high and your screw down is travelling over 50 fpm. How much trouble do the mill operators have in handling that speed? How much jamming trouble is encountered and do you have un-jamming devices to help your motors get the rolls separated?

Another question arising is whether you can actually keep limit switches working on the manipulator side guards and screw downs. Do you also have slow down limit switches?

My last question is in reference to spares for the auxiliary motor-generator sets. What spares, such as complete motors, stators, or rotors do you carry for the motors driving the sets?

A. W. Smith: First, to answer Mr. Bangert's questions. It is very true that there is an additional expense in making a mill that can reverse as rapidly as this mill does. It is an additional expense to laminate the frames of the generators and motors. The main reason for laminating the main rotating equipment frames is to get the improved commutation under suddenly changing load conditions. The fact that the machines give you a little faster response with laminated frames comes along, you might say, with no additional cost. With solid frames, you would be able to get just as fast a reversal as we have here by using a higher forcing voltage on the regulators. As new mills are considered, we work together with the customer to determine whether the advantages gained with laminated motor frames warrant the extra cost, or whether the solid field frames would be satisfactory as they have been in the past. On all our mills, we use the laminated field frames on the generators.

To answer Mr. Miller, it would be of some advantage to laminate the generator exciter frame, but by using a high forcing voltage, we are able to get good response out of the regulator on this mill with solid frames on the exciters.

We do not have a pulpit adjustment for unbalancing the loads on the motors, but such adjustments can be made in the motor room. We are continuing to learn of the rolling characteristics of these twin drive mills and just what can be done to affect the curvature of the slab as it is delivered from the mill. Some of the operating people seem to have been able to correct the turning down of the steel with adjustments in the motor load balance, while others have seen very little effect.

Mr. Montgomery is correct in saying that you need very good current limit on auxiliaries, because we do operate auxiliaries with generators directly connected to motors, with no contactors. For this mill, one of the tests we performed was to short the screwdown generator and apply voltage with the master switch. Under these conditions, which are of the worst that could be imposed, the regulator did a very good job of limiting load currents.

To answer Mr. Graham's questions, the feed roll arrangements as to full voltage motors connected through gears to feed rolls or low voltage motors connected directly to feed rolls, are mainly a mechanical problem. The maintenance of mechanical equipment is the main consideration. Mr. Kaufman can probably tell you about the advantages of high speed screws, and if any difficulty has been experienced for the operators to handle such high speed equipment. There is a slow down and a stop on the screws to prevent jamming, and so far as I know, there has been very little difficulty as far as jamming is concerned. For the driving motor on auxiliary motor-generator set, there is a spare armature and also spare field coils. You might very well see that that is a weak link in the drive. The mill would be down long enough to change armatures or fields, if one of these driving motors are to fail.

George Kaufman: We are very pleased with the operation of this new mill at South Side. On completion of the erection of the mechanical equipment, the mill went into production without delay.

The few times that the screws have jammed, we have been able to unjam with the crane.

This mill is fed from two sets of soaking pits. The new pits are in line with the mill and are served by a pot-type buggy. A roller type buggy is used to carry ingots from the old pits that are in an adjoining building.

When this mill was first discussed, a universal mill with edgers was considered, since a high tonnage of slabs was to be rolled, but with the use of high speed screws and manipulators, we are doing the job with a high lift mill. We saved in the initial cost of the equipment, and we also have a mill that can roll blooms in the future, if the need arises.

J. D. O'Roark: Are you able to give us production figures for 8 hours and 24 hours.

J. H. Mayer: To date we believe we have good tonnage figures on this new mill. Our 8-hour record is 3000 net product tons, and the 24-hour record 7200 net product tons. To date the best hourly rate has been 430 product tons.

H. H. Angel: I would like to know more about feed rollers. Do you have trouble with feed rollers stalling when entering a short ingot?

J. H. Mayer: We have had no trouble with stalling the feed rollers on this mill. Our installation has each feed roller independently driven.

Plan to Attend **1954 AISE SPRING CONFERENCE**

PHILADELPHIA, PA. **MAY 3, 4, 5**

HIGH SPEED CONTINUOUS ANNEALING OF TINPLATE

By M. D. STONE
Manager, Development Department
and
E. A. RANDICH
Engineer, Development Department
United Engineering and Foundry Co.
Pittsburgh, Pa.

. . . . steel plant engineers and the builders of mill equipment, furnaces and electrical equipment combined their talents to produce an outstanding development in steel plant equipment . . . . as a result the steel plant can produce good tinplate faster and more economically . . . .

▲ WITH the advent of strip mills, the practice of strip annealing after cold rolling tended to follow earlier sheet practice, differing only in that batch annealing of coils replaced the earlier batch annealing of sheet packs. The possibilities of continuous annealing were confined in the earlier days to the higher cost steel products, such as silicon strip for electrical applications, stainless steel strip, and the like.

One of the early continuous annealing installations is described by Prentiss[1]* where strip was handled through a roller hearth furnace having a maximum temperature of 1900 F—the strip having a maximum width of 36-in., a gauge range of 0.013 to 0.031-in., and a top speed of some 30 fpm. A unique advantage for this type of product was that the resultant coil was free of "coil-set," and could be fed flat into the punch press lines. The risks of surface scratches were eliminated in a subsequent development, where catenary heating zones were employed—and this type of continuous annealing for both silicon and stainless strip has persisted up to the present—all, however, at relatively low speeds of less than 100 fpm, and production capacities of under 2 tons per hr.

Around the middle '30's, significant steps were taken in the continuous annealing of low carbon strip, such as auto body sheets, etc. Here, different considerations necessarily entered into the picture, as a high production, low cost product was being handled. Could satisfactory properties be obtained at justifiable costs, and what were the metallurgical consequences of such speeded-up processing? Papers by Hague and Brace[2] and Otis[3] at this time delved thoroughly into the subject. Coil annealing cycles required many hours—up to a week with natural cooling and three days with forced cooling—and the possibilities of cutting the time down to fractions of an hour were attractive. Time cycles of from 5 to 15 minutes were worked out, and detailed studies of the thermal cycle indicated that 9 minutes was perhaps the optimum, using a maximum temperature of 1700 F. A 7½ ton per hr continuous furnace line, as described by Hague and Brace and in which the present authors' company was also involved, was built at that time for the Ford Motor Company. The gen-

*See Bibliography at end of paper.

eral arrangement of the line was horizontal in nature, some 425 ft long, including a 325 ft long heating and cooling section of the driven roller hearth type, supplied with bright atmosphere equipment—and could handle 0.050-in. maximum gauge strip, 50-in. maximum width, at speeds up to 50 fpm. The lowest consistent hardness that could be obtained were from 52/56 Rockwell B—as compared to 40/44 Rockwell B for coil annealed material—and in spite of the finer grain obtained, the product was not as suitable for deep drawing purposes, and could offer no compensating attraction, such as less cost.

The matter of continuous versus coil annealing must be properly and carefully weighed in every case. For sheet stock, Olt's[4] discussion of the subject strikes the reasonable balance that must be preserved in such matters. For the production figures attained, investment costs per ton of capacity are of the order of 100 per cent more than for coil annealing—and operating costs considerably in excess. Metallurgically less desirable properties can be achieved for deep drawing. Against these, the arguments of better uniformity of product, less inventory of material, shorter delivery time, etc., have not prevailed. However, where multiple operations can be combined into a single continuous operation, such as continuous galvanizing, including annealing—and where metallurgical requirements are not so drastic, and where production capacities are up (to 10-15 tons per hr), then the continuous process has and will continue to firmly establish itself.

The possibilities of the continuous annealing of tin plate were a natural and collateral interest of the steel industry already studying the sheet problem, as discussed above. The first company to venture commercially into this field was the Crown Cork and Seal Company of Baltimore, Md. in about 1940, as mentioned by Keller[5]. This company, manufacturing tin plate for its own consumption, has special products to make (bottle crowns, etc.) that do not require the lower tin plate tempers. Because of the lightness of tin plate gauges 0.007 to 0.018-in., and the length of strip in process to obtain any sort of tonnage at reasonable speeds, Crown Cork adopted what has been termed the tower type of furnace. In this furnace, to reduce the length of line to acceptable values, the strip passes vertically between an upper and lower set of rolls—all surrounded by furnace walls and cooling ducts, and filled with a "bright" atmosphere. Some precedent for this type of furnace was established some few years eariler, about 1936, at the Midland plant of the Crucible Steel Co., who were experimenting with a process producing dual electrolytic coated strip. Between the first electrolytic deposition, of copper or nickel, and the second electrodeposition of tin, the strip was passed continuously through a tower furnace which heated the strip to 1800 F, and then cooled it in a horizontal cooling zone, to about 150 F. The purpose of this furnace was primarily to fuse the base electro-coating, and only secondarily to soften or anneal the strip.

As described by Ryan and Ackley[6], the furnace handled two 20-in. wide strips, side by side, over a single top roll. The electric heating chamber was 54-ft high, accommodating some 107-ft of strip in each strand. The succeeding horizontal cooling section was 52-ft long, and was water jacketed. A protective atmosphere was used to prevent oxidation. At 50 fpm maximum speed, corresponding to a minimum thermal cycle of more than three minutes, the capacity of the furnace was 1 ton per hr per strand, and the power consumption about 150 kw hr per ton.

Crown Cork's first line was based on a nominal maximum speed of 200 fpm, which for average strip conditions of 30-in. x 0.10-in., was capable of a peak production of some 6 tons per hr. Shortly after the first line was in operation, Crown Cork built a second higher speed line, having a top operating speed of 300 fpm, reflecting the experience gained in the first line, and stepping up the maximum production to 9 tons per hr, thus taking the next logical step to make the process economical.

Some few years later, in 1945 the Dominion Foundries and Steel Co. of Hamilton, Ontario, put into operation essentially a duplicate of the second Crown line, which indeed was designed by Crown Cork. This line has been described in considerable detail[7] in recent publications. It is evident that Crown Cork early appreciated the necessity and possibilities of short cycle low temperature annealing of tin plate—as a minimum overall cycle of some 90 seconds was provided for. The heating section of the furnace, for instance, consisted of four 34-ft vertical passes, and the holding and cooling section consisted of eight 38-ft passes—corresponding to a total length of strip in the furnace of some 500-ft. It was already common knowledge at that time that the more low carbon steel was cold worked, the lower the recrystallization temperature—and hence the 80 to 90 per cent cold reduction used in tin plate manufacture permitted an optimum annealing temperature of 1250 -1350 F, whereas the 55 to 65 per cent cold reduction usually employed in sheet manufacture required temperatures as high as 1750 F.

Actually the early developments appreciated that there existed no limitation in the rapidity of heating, as long as a minimum holding time at temperature of 15 seconds was maintained, and a slow cool down to around 900 to 1000 F in about 15 seconds was held. However, these exact bits of knowledge came only with experience, and in order to obtain acceptably low ultimate hardnesses, retarded cooling in the upper temperature ranges was mandatory. In the existing installations, this could only be accomplished by increasing the rapidity of cooling in the lower temperature ranges, which was accomplished by quenching in water below 400 F.

Another feature common to the first installations at Crown was the omission of any cleaning operation, electrolytic or otherwise, ahead of the furnace. While this practice is acceptable for certain products, it is felt this operation cannot be dispensed with for general applications. In addition, the carbon deposits, resulting from burning off of the oil, tended to deposit on the electrical furnace resistors—and required regular shutdowns for removal, to prevent malfunctioning. Other features of these lines included the use of only single recoiling reels, hand shearing of coils at the reel, and no belt wrappers—the lower operating speeds, of course, permitting these. In addition, the furnace atmosphere gases were of the DX type, resulting in less satisfac-

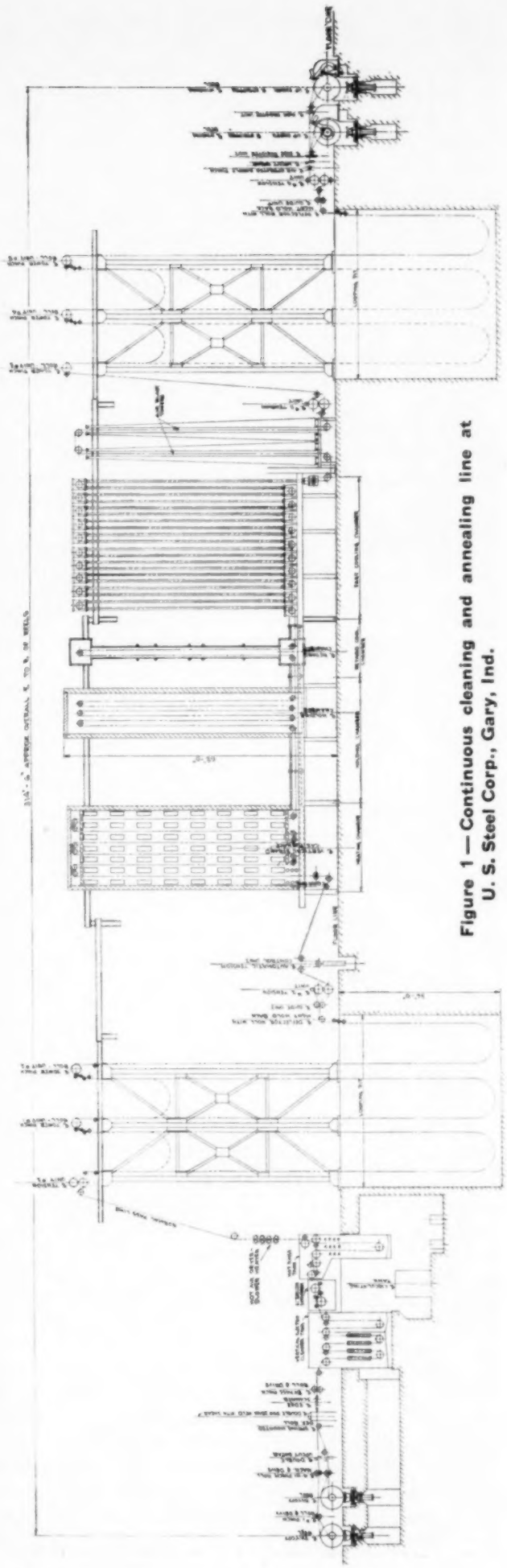


Figure 1 — Continuous cleaning and annealing line at U. S. Steel Corp., Gary, Ind.

tory surface cleanliness and causing periodic gas puffs or explosions. A major point of departure in the Dofasco installation over the earlier Crown lines was the addition of a chemical cleaning section as an integral part of the equipment, being located immediately ahead of the first looper—this permitted wider commercial use of the product, as mentioned earlier.

With the value of continuously annealed tin plate established as a desirable product, it was only natural that subsequent thought concentrated on the economical side. The possibility of substituting gas fired furnaces for electric—to reduce fuel costs, was the first obviously desirable move. And the desirability of reducing investment charges and labor costs by increasing line speeds, and consequently production rates, has been equally as promising, if not more so. In coming now to the most recent developments along these lines, we wish to mention that two other lines have been put into operation in the interim period between 1945 and 1951: one, rated at 7½ tons per hr utilizing the gas fired radiant tube type furnace, and the second, rated nominally at 20 tons per hr, utilizing radiation type gas firing. As nothing has been published in detail on either of these installations, we proceed now to what must be recognized as the acme in continuous tin plate annealing lines.

The first of these lines was put into operation in the summer of 1951 at the Gary Sheet and Tin Mill of the U. S. Steel Corp. This line is capable of handling cold reduced low carbon, capped, rimmed and killed steel strip for finished tinplate and black plate products 0.0075 to 0.015-in. thick, 18 to 37-in. wide, received at the line in coils 16½-in. inside diameter x 66-in. outside diameter, weighing 30,000 lb maximum, at a line speed of 1000 fpm. The capacity of the line is some thirty tons per hour, based on an average strip 0.010-in. x 30-in. wide at 1000 fpm. The general arrangement of this line is shown in Figure 1.

Here the handling of strip is divided into three zones: the uncoiling, the furnace, and the recoiling zones. At the start of the first zone are two uncoilers, which are serviced by ram trucks which bring the coils to the line from the cold mills, and deposit them on the coil cars. These uncoilers are of the expanding mandrel type and are hydraulically adjustable laterally for variable coil widths and automatic strip centering, and are provided with rotating type air cylinders for mandrel expansion. The pass line height is kept to a minimum for good visibility and ease of operation. Coils are easily and properly centered on the uncoiler drum by a spotlight device which indicates where the edge of the strip is to be located. The strip is then threaded through the pinch roll unit which feeds the strip as it passes to the double, upcut type snip shear. A side register device automatically aligns the entire uncoiler and drive by lateral displacement with respect to the center line of the furnace. The welder is a special double seam welder with built-in air snip shear and variable transverse speed control. An edge scanner is provided to signal the operator that defective strip is being uncoiled, and thus gives the operator the opportunity of changing coils so as to keep strip with badly cracked edges and bad shape from being further processed. An air operated pinch roll unit is mounted just before the cleaning section and serves

the purpose of establishing a by-pass line to the main entry pulling bridle if and when the cleaning section is being serviced.

A full cycle vertical type electrolytic cleaning section is provided, having four electrolytic passes and two non-electrolytic passes in the cleaner tank. Provision is made for about three seconds of electrolytic cleaning plus one and one-half seconds of non-electrolytic cleaning at 1000 fpm. A large recirculating tank, mounted in the basement recirculates the hot caustic solution and clean make-up water. The scrubber unit which follows is of the four-brush type, large back-up rolls being provided with two brushes mounted above the strip and two below. A multiplicity of spray nozzles is provided to spray adequate quantities of hot water on the strip at the points where the strip is being brushed. The hot rinse tank houses a pair of wringer rolls at the entry side which "squeegees" the carry-over from the scrubber so as to keep the rinse water clean. The strip makes a double pass through the hot clean water and is sprayed by a large volume of high pressure water at entrance to and exit from the rinse tank. On passing out of the hot rinse tank the strip is passed through two pairs of wringer rolls which have rotating type seals permitting axial removal of rolls. Tanks have hoods of the easy removal type. All rolls are mounted in roller bearings on pedestals, independent of the tanks. A large fume exhauster and fume washer, as well as a moisture eliminator, complete with exhaust ducts and stack, are incorporated to remove all steam and fumes. The cleaner section is located ahead of the entry looper tower to prevent oil from contaminating the looping tower rolls. This cleaner provides the full equivalent in cleaning capacity of the conventional separate cleaning lines in general use today.

Figure 2 — Entry end of the continuous annealing line, shows pay off reels, cleaner section and entry looper tower.

The strip then vertically passes up through a quadruple head V-type steam heated air dryer to the No. 1 tension unit or entry pulling bridle, which bridle is mounted along with the No. 1 and No. 2 pinch roll units atop of the entry looper tower. Each tension roll of the entry bridle is independently driven by a motor through a gear reducer. Roller side guides are provided ahead of the pinch roll units, and are adjustable from floor level by means of push button control, a weighted cable and calibrated indicator device being used to indicate guide position.

The looper tower is a welded steel structure about 60-ft above floor level and provides the means whereby some 360 feet of strip can be stored. The strip extends some 30-ft below floor level into deep pits, as shown. Loop control is by photo electric eye and is of the modulated type. Plywood sheeting and timbers line the various vertical members so as to keep the sway in the strip, which is at times encountered at high speeds, from fouling on the structural members. Two disappearing platforms are provided for ease in threading strip through the tower units.

At the entry to the second or furnace zone, is located the No. 2 tension bridle, which in conjunction with the automatic tension control unit, provides the proper back tension to the strip before it enters the furnace. A strip guide unit consisting of multiple deflector rolls and guide flanges, drag magnet, etc., provides for accurate guiding of strip as it enters the furnace. The automatic tension control unit consists of a vertically movable roll which is constantly actuated through a rack and pinion arrangement from a torque-motor. This unit functions in conjunction with the No. 2 drag tension bridle and the No. 3 pull tension bridle. This latter unit is located at the exit end of the furnace and is the keynoter for the entire line. The tension setting at the automatic tension unit is made by the operator who sets a rheostat which electrically controls the field of the torque-motor and thus establishes a definite tension in the strip. If the position of the tension roll varies too much, it will then intercept a light beam causing the No. 2 drag bridle to speed up or to slow down, automatically, keeping strip tension constant. The strip then passes over a deflector roll, through a pair of air operated and motor driven seal rolls, and into the furnace proper.

The furnace is a combination gas and electric annealing furnace, having an overly ample capacity of 40,000,000 Btu per hr in the gas heating section, and 925 kw in the holding and cooling sections, which corresponds to 7 per cent of the total heating capacity. The furnace is designed for an output of 30 tons per hr of 0.010 in. x 30 in. wide steel strip when heated to a temperature of about 1350 F by means of the gas fuel. The thermal cycle is based on heating up in about 20 seconds, holding at temperature for a period of about 15 seconds in the electrically heated chamber, slow cooling to about 900 F in about 15 seconds, followed by a rapid cooling to 200 F through a series of water cooled ducts before being exposed to the air. The total overall furnace cycle therefore takes some 105 seconds, this cycle taking place under controlled atmosphere conditions. Below 200 F, this strip is further cooled first for about 7 seconds in blast air cooling, and then for about 15 seconds

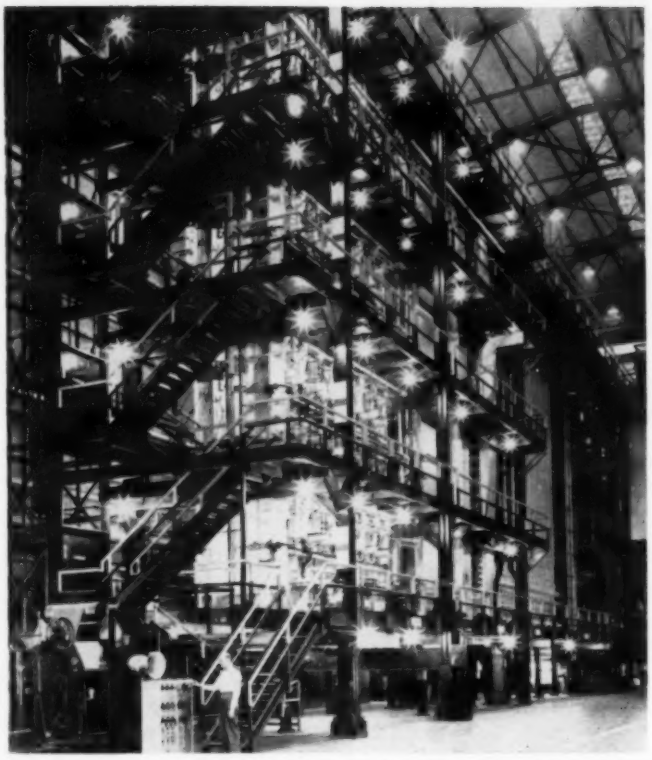


Figure 3 — Entry to vertical strand gas furnace shows drag bridle and automatic tension control unit.

in relatively still air, before going into the reeling zone at about 125 F.

The first section of the furnace consists of a coke-oven gas fired chamber comprising six passes of strip, having an effective heating length of about 325 ft. The heating chamber is equipped with gas-fired radiant tubes of a "W" shape, which are exhausted at negative pressure by means of eductors, leading to a vertical stack and then out of the building proper. The gas fired radiant tubes of 25 per cent chrome, 12 per cent nickel alloy are designed for a maximum safe temperature of 1850 F and for continuous operation at about 1750 F. Actually the tubes can be operated considerably under these temperatures because of the excess capacity mentioned previously. All rolls in this portion of the furnace are centrifugally cast, 25 per cent chrome and 12 per cent nickel heat resisting alloy. There are six zones of control, of the on-and-off type, using radiation pyrometers for temperature pickups.

The electrically heated holding chamber is designed to hold the strip at temperature for some 18 seconds at top speed and contains six passes of strip corresponding to about 300 ft in length. This chamber has a maximum heating capacity of 700 kw and is divided into four zones of control, with the two main circuits arranged for reconnection for low power during normal operation, high power being used only to accelerate the initial heating-up period. At high speed operation, it has been found that practically no heat is required in this chamber.

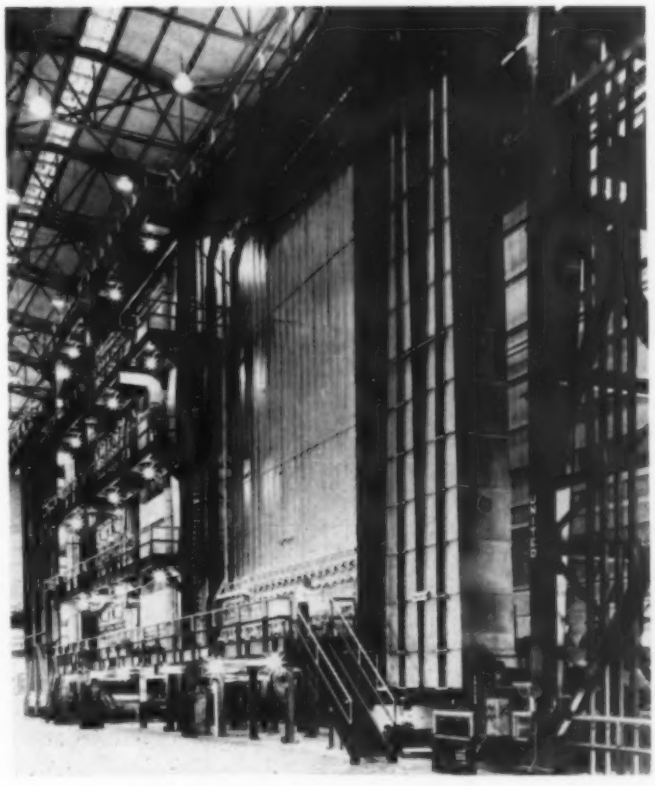
The retarded cooling chamber is equipped with 225 kw of heating elements comprising two passes of strip corresponding to about 100 ft of length and is designed to allow the strip to cool to 1200 F in about 6 seconds at top speed. Actually the total controlled cooling zone extends into the first part of the fast cooling chamber, where the 900 F controlled temperature is reached in about 9 seconds more. Resistor type electric heating elements and controls are used to initially bring the chamber to the proper operating temperature and also to maintain the chamber temperature should the strip stop or slow down appreciably. This chamber is also equipped with air cooling tubes and two blowers for removing heat from the chambers, when this type of thermal control is called for.

The fast cooling chamber consists of 20 passes of strip, passing through a series of individual water jacketed ducts and provides for some 61 seconds of rapid cooling, of which 9 seconds are included in the previous cycle, as explained. This chamber ultimately reduces the strip temperature to 200 F. Two blowers are provided, to recirculate the protective atmosphere so as to create considerable turbulence and thus accelerate the heat transfer from the strip to the watercooled walls of the chamber. The strip length in this chamber is 1025 ft, making a total of 1750 ft of strip under controlled atmosphere conditions.

Protective atmosphere is utilized in all zones and provisions have been made for supplying some 12,000 cfhr of neutralene or NX gas which consists of approximately 93 per cent N_2, 5 per cent H_2, and 2 per cent CO. This gas is supplied from a modern and complete gas generating plant installed previous to the installation of subject line. The use of this type of gas over earlier lines, provides cleaner strip and reduces the hazard of gas puffs or explosions, to practically nil.

An industrial type elevator with accompanying structural framework is provided along with five levels of platforms and walkways. A gasoline engine type fork truck is provided for removing and/or replacing bot-

Figure 4 — Exit end of furnace section shows fast cool ducts, air blast tower, main pulling bridle and exit looper tower.



tom furnace covers when strip breakage occurs. Ample sight glasses are provided throughout for looking down along the strip in the many passes. The top covers on the heating furnace have three slotted ports for aid in threading in case of strip breakage. Furnace tube and/or roll removal is by counter-weighted porterbar through the furnace walls, which have removable port covers for the purpose.

The final section is the external blast air cooling tower covering some 120 ft of strip, arranged as two vertical passes, the strip passing between wind boxes having slotted nozzles, the wind box air being supplied from the surrounding room by means of two blowers.

Proceeding further, we come to the No. 3 tension unit, whose function has already been described. Next comes the delivery looper tower, which performs the same function as the entry tower except that the strip is normally held in the upper position, instead of the lower position, so that when the delivery zone is stopped, strip can be stored in this tower. There are three pinch roll units mounted on top of the tower, fitted with guide units, controls, etc., as described for the entry looper tower.

The third or recoiling zone consists, first, of the No. 4 drag tension bridle which is similar in every way to the No. 2 bridle, whose function is to provide back drag, against which coils are wound under controlled back tension. Additional recoiling zone equipment consists of an air operated and laterally movable sample punch, to punch out small discs for metallurgical control, followed by an air operated upcut type snip shear. For rewinding, there are two collapsible reels with built-in grippers as well as belt wrappers, expanded and collapsed by rotating type air cylinders, complete with coil cars, photocell type side register devices, as well as air operated flipper gates. The coils are hydraulically stripped from each reel onto its coil car, which is hydraulically traversed, and deposits the coil onto the upender. The upender rotates the coil 90 degrees, from which position the crane removes the coil by means of lifting tongs. Coil removal can be carried out leisurely and conveniently since the time interval between coils may range from 10 to 30 minutes, even at maximum operating speed, depending of course on the size of coil being processed.

A complete hydraulic system is provided for the entry zone equipment, as well as a separate system for the delivery zone equipment. Pressures are maintained by pumps in conjunction with accumulator bottles. The hydraulic systems are located in the oil cellar under the entry and delivery zones.

The electrical equipment may be of some general interest on this type of line. The entire line is driven from a single adjustable-voltage motor-generator set, comprising a 600-hp, a-c motor, driving three d-c generators, feeding each of the three operating zones—a 150-kw generator for the uncoiling zone, a 150-kw generator for the furnace zone and a 125-kw generator for the recoiling zone. Driving the various pieces of equipment are some 90 d-c motors, comprising a total of 1500 hp of installed capacity, varying in size from 1 to 225 hp. Various constant speed pieces of equipment are driven by some 50 a-c motors, having a total installed capacity of 1250 hp, varying in size from ¼ to 600 hp, the latter

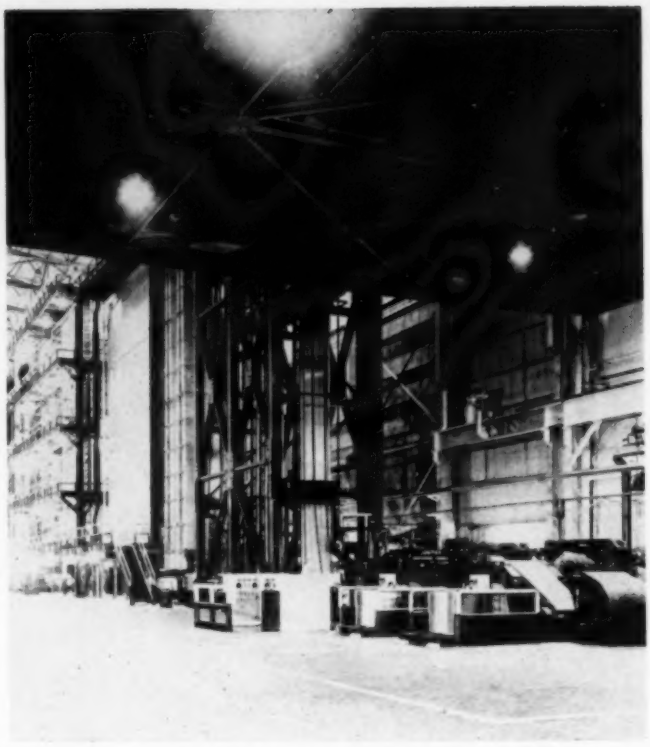


Figure 5 — Delivery end of line shows exit looper tower, winding reels, upenders and control station.

including the electro cleaner motor-generator set motor. In general, it may be said that all main strip carrying rolls are individually motor driven from the main motor-generator set, including some 15 cleaning section rolls and 49 furnace rolls. In operation it has been unnecessary to actually drive all furnace rolls, but it has been advantageous at times, and particularly when threading the furnace, especially after a strip break. The a-c and d-c control panels are said to be among the largest ever installed in any steel mill, the a-c control panel being 106 ft long and the d-c 92 ft long.

The entire line, which is some 321 ft long by 43 ft wide including the control stations, by 65 ft high (at the furnace and looper tower levels) is housed in a new building some 340 ft long by 65 ft wide, with a ceiling height of 76 ft. The delivery end of the line extends into an older building which houses the overhead crane that accepts coils from the upender. The new building is provided with two 7½-ton service cranes for roll and tube maintenance, and the like. The line has already exceeded its maximum rated production of 30 tons per hr, and it is anticipated that its annual output will exceed 200,000 tons.

As to the type of product produced off the Gary line, little additional can be said that has not been said before, particularly in Weir's[7] article cited previously—this type of product is finding increasing favor. While tempers T_3, T_4, and T_5 are more easily and economically produced by the continuous method than by the batch, it is not beyond expectation that this product will also be suitable for T-2, and perhaps even T-1 applications, because of the favorable drawing qualities of this finer grain product. The greater uniformity of properties not available in the coil annealed product, plus the more satisfactory surface conditions, are still other desirable aspects of continuously annealed tin-

plate. Lack of "stickers" and the lesser amount of temper rolling required, not only are economic advantages, but make for less scrap loss as well. A perhaps surprising dividend resulting from the continuous anneal is the improvement in flatness of the product leaving the line as compared to its condition when coming to the line from the tandem mills—the slight stretching in the hot furnace zone is the explanation. To many operators, the reduction in in-process inventory from seven days to three days, and eventually to one day, is perhaps the dominating consideration in favor of the continuous process. To this, however, must be added consideration of many other economic factors, some of which are shown tabulated in Table I.

Based on the factors enumerated above, it is to be expected that the continuous annealing of tinplate is on a firm economic basis, and not apt to be upset for lack of consideration of such aspects as entered into the continuous annealing of strip-sheet. In fact, the new Fairless plant of the United States Steel Corp. has

TABLE I

Comparison of Continuous Cleaning — Annealing Versus Batch Annealing and Cleaning Based on Production of 200,000 Tons per Year

	Continuous cleaning and annealing	Batch annealing and cleaning
Floor space, sq ft	22,000	36,000
Equipment investment, per ton	$1.00	$0.80
Charges at 10 per cent per year		
Fuel consumption (gas), Btu per ton	700,000	900,000
Neutral atmosphere, cu ft per ton gas	500	1,000
Direct labor, man-hr per ton	0.25	0.33

an essentially duplicate line, slightly wider, and differing only in some few minor details. This installation should further consolidate the considerable strides that the Gary line must be recognized to have made.

An important factor in the successful engineering of such a complex of equipment has been, we feel, the singleness of responsibility for the entire line, with the exception of the electric drive equipment. We wish to emphasize the importance of joint united effort of the various equipment designers and builders working with the engineers and operators of the producing company in carrying through to successful conclusion new developments such as this line represents.

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DISCUSSION

PRESENTED BY

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D. A. McARTHUR, Chief Engineer, Wean Engineering Co., Warren, Ohio.

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EMIL KERN, Vice President in Charge of Engineering, Allegheny Ludlum Steel Corp., Brackenridge, Pa.

E. A. RANDICH, Engineer, Development Dept., United Engineering and Foundry Co., Pittsburgh, Pa.

J. D. Keller: This is a very interesting paper, showing an installation which indicates great progress over a period of time, and having a really commercial production rate. To me, the chief interest of the paper consists in showing the time lag in the steel industry, or probably any industry, which elapses between the first proposal of an idea and its more or less general acceptance.

We all know that the Crown Cork and Seal furnace was one of the first in this country. However, I might mention that Prof. Trinks found in his visit to Germany before the last war, that even prior to the Crown Cork furnace there had been other such furnaces. There was the Rohn furnace, and another one, both electrically heated, and used prior to the Crown Cork furnace.

In April of 1940 I read a paper at the Birmingham meeting of the AISE on the subject of continuous strip annealing. That paper was by R. J. Wean and he not being able to be present, I read the paper for him. Then about a year later, in May of 1941, here in Pittsburgh at the ASME meeting, I gave a paper on the same subject. Figures 6 and 7 show what was proposed at that time, and which was then installed at Niles. That type unit at the Republic Steel plant at Niles, Ohio, is as far as I know, the first gas-fired continuous annealer. It was also of the tower type. I think it will be found that most of the features that have been present in the later furnaces, such as the one now described by Dr. Stone, were also present in that furnace. But the degree of development has been really remarkable, from the rather low speeds obtainable at that time to the speeds of 1,000 fpm which are now attained.

Figure 6 shows at the left a looping tower and then the furnace, and the cooling chutes. These were gas-fired tubes running crosswise. That was not according to my own ideas; I favored the vertical tubes at the time, but the cross tubes were the ones that were used.

I think it will be evident that as far as the general features are concerned they are all there in this furnace. This is about what was installed and operated commercially in the Niles plant. It was operating in 1941, and I think on into 1942. Then came the war, pro-

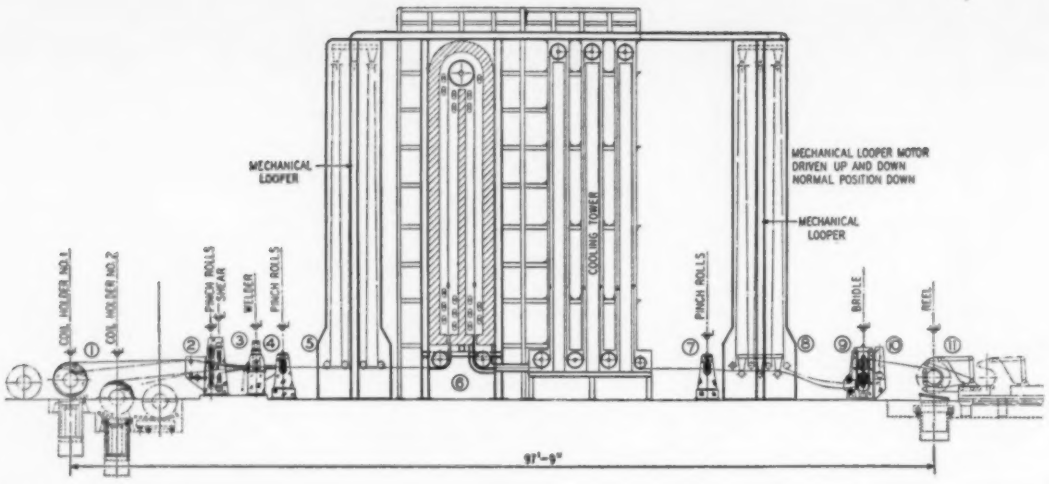


Figure 6 — Gas-fired tower-type strip annealer, shown was built in 1941 at Niles, Ohio.

duction requirements changed, and after a time this furnace was taken out.

Figure 7 shows in a little greater detail the two-pass heating zone, and also the cooling tower. The interesting thing in the new development is not so much in the introduction of new ideas or principles as it is a matter of degree. I would like to ask Dr. Stone and Mr. Randich if it is not true that the general principles and the general ideas were all there in the 1941 design. Admittedly, however, there has been really remarkable progress in increasing the strip speed.

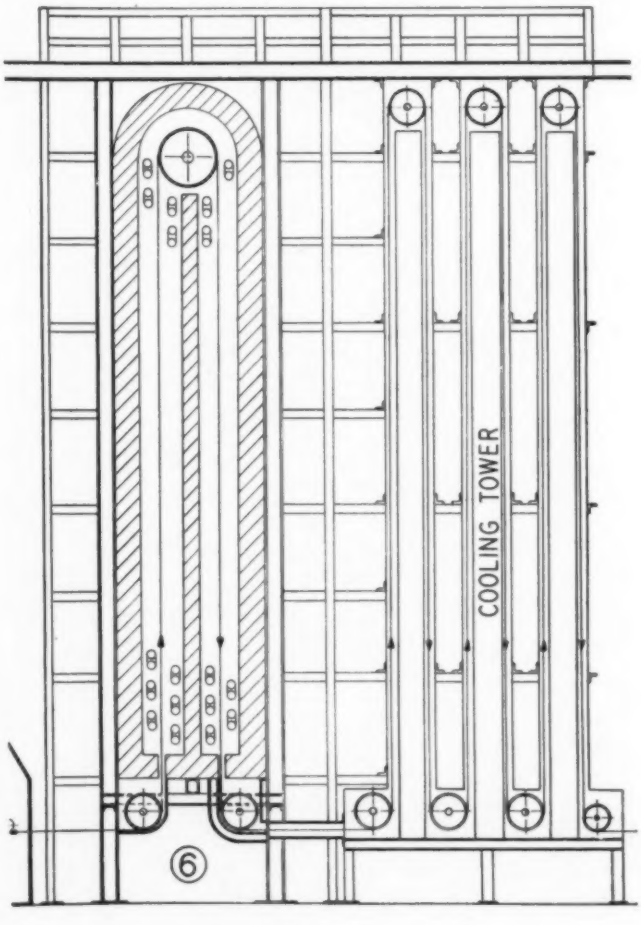
There are one or two other things that I want to bring out. The retarded cooling was, I think, first mentioned by Dr. J. B. Austin in the discussion of my paper in 1941. He questioned whether quench hardening would not be produced by rapid cooling, which was favored at that time. However, I think the practical working out of that had already been done at Crown Cork and Seal, where they found retarded cooling was necessary; retarded cooling right after the heating, in order to get the desired softness.

To sum up this matter, nothing has been said as to the relative merits of coil annealing, which has been the present method, or the method at present chiefly used, and the continuous annealing now favored. When my paper was read in 1941, being somewhat enthusiastic at that time about continuous annealing, I ventured the prediction that by far the greater proportion of strip production would be continuous-annealed within a very few years. I was far off on that. Of course the war came in between.

But there was also a good reason why the prediction was not fulfilled. At that time, we were told that all you have to do is heat the steel up to probably not over 1250 or 1350 F on low carbon steel, and hold it there. We were assured by metallurgists that that was correct. Since then, we have been told that there is a slight holding time required, and the length of that holding time depends on the degree of softness desired. For a good many products, the Niles furnace, or the Crown Cork furnace, or the furnace shown here, has sufficient holding time to give the desired ductility and softness for a good many uses, such as crowns, and can bodies, where you do not have deep drawing. But where anything requires deep drawing, I think it is now more or less recognized that continuous annealing as presently practiced is not capable of producing a soft and ductile enough material. To do that, you might have to hold it at temperature for a period of maybe, three minutes. Of course if you do that, namely, try to get a speed of 1,000 fpm and also hold at temperature for three minutes, it almost puts continuous annealing out of the question, because the size of the furnace required becomes prohibitive.

If it were true that you merely would have to get the strip up to annealing temperature and then cool it down, I still think the way to do it would be by convection heating, as shown in a patent issue to me about about 1943 or 1944, showing how that can be done by a specially designed regenerator where you heat the at-

Figure 7 — View shows details of furnace of strip annealer shown on Figure 6 and details of cooling chutes.



mosphere gas to a very high temperature and circulate it through the heating passes. You could get in a very small space an extremely high heating rate. It would do no good, of course, if you had to have a holding time, say on the order of three minutes. So I came to the conclusion that coil annealing is something we will always have with us for certain products. Continuous annealing has its place, and a good place; it will grow, but we will still have both, continuous annealing growing and coil annealing remaining.

There are a few things I would like to ask in the way of questions. One is whether scrapers on the rolls in the furnace have been found necessary? In those days, around ten years ago, there was some question as to whether pickup would not occur. It is always a problem in normalizing. I think it was one of the reasons why those higher temperature furnaces were not very successful. But there was some question whether pickup would not occur even in a furnace of this type, and unless I am mistaken, scrapers of certain kind were used in the Crown Cork furnace. I would like to know what was used in the Gary furnace.

Then there had been some difficulty in strip tending to run toward the side, especially in the cooling zone. Cooling produces a certain instability, and the strip tended to run to one side and rub, and perhaps turn the strip edges on the guides. I would like to know whether any such trouble has been encountered.

Another thing I think we would like to know is: how frequent are the strip breakages? They cannot be very frequent or the furnace would not be too successful. A rough estimate of how frequent they are would be desirable.

Then there is the question of variation in hardness across the strip, something for which there is no way of correcting. It was found in the Niles furnace that there was at times a difference of about three Rockwell points in the hardnes from one side of the strip to the other, due not to the heating but to the variation in the strip steel itself, and with cross firing there was no way to correct that. I would like to know if that has been found in this case.

One thing that I think should be taken into account when evaluating continuous annealing is that, just as in the continuous mill, you do not have the flexibility of the batch type of operation. If you have long runs of one particular product, that is where continuous-mill rolling or continuous annealing shows to best advantage, but if you frequently have to change gage and width, batch annealing then has its advantages.

M. D. Stone: I will try to answer some of the questions. As Mr. Keller says, in general there is nothing new in the continuous annealing of tinplate, I think it is ten years old or more. But this one is working at high speeds. We would be interested in why the Niles furnace did not continue. As to the scraper, there is none, it is not needed.

J. D. Keller: Is there a tendency to run to the side, especially in the cooling zone?

M. D. Stone: Oh, yes, you get problems of that sort. But we have the line running very nicely now. There are little tricks that the operators learn and it makes a lot of difference. It has happened, probably it will happen. But gradually it is disappearing.

D. A. McArthur: I thought I would get up and answer Dr. Stone's question about what happened at Niles. It was a good question.

We obtained from that furnace practically identical results metallurgically to the furnaces that are operating now at Crown Cork, Wheeling, Dominion, and Gary, and they are good results now and they were good results at that time. But they are not the same as box annealing, and I think that is something that all of us will have to remember. A continuous furnace may make better product, but it does not make the same product as box anneal, and probably it never will. In 1941 Republic Steel wanted the same product, and though we made just as good as is being made now, it was not box annealed product.

One other thing I want to say. No one mentioned the first continuous annealing of tinplate, but on a continuous tinplate annealing line in 1931 about a hundred yards from the present furnaces at Gary, I bet we made metallurgical properties that are the equal of any that are made at Gary now.

A. R. Ryan: Although the authors have described the installation quite thoroughly, there are several other features that might be of interest.

The furnace heating chamber is operated at a temperature appreciably higher than that to which the steel strip is heated. This is done to accelerate heating. There are occasions when the strip must be stopped. When this occurs the strip heats to full furnace temperature very quickly and the strip supporting rolls stop rotating. If the rolls were allowed to stand idle for any appreciable length of time, they would probably warp or sag to such extent as to make high speed operation impracticable. To prevent such distortion of the rolls, each roll is provided with an auxiliary drive to rotate the roll slowly allowing it to slide on the stationary strip. Cumulative pull on the very hot, low strength strip, is avoided by rotating the two rolls at the top or bottom of a loop, counter to each other.

The cooling chamber of the furnace is also of considerable interest. It consists of twenty, vertical, water cooled chambers, each about fifty feet high and of rectangular cross section arranged for the hot strip to pass up or down vertically between the water cooled walls of each chamber. The twenty chambers are joined alternately at top and bottom by gas tight enclosures that also house the strip supporting rolls. Much of the required cooling is obtained by direct radiation of heat to the water cooled walls. When necessary it is possible to circulate protective atmosphere at high velocity along the strip and by turbulent flow, remove additional heat from the strip and transfer the heat to the water cooled walls.

The furnace is divided into separate chambers for heating, holding, slow cooling and fast cooling. The strip passes from chamber to chamber through insulated throats connecting the chambers. This arrangement permitted each chamber to be designed for its specific purpose without regard to other chamber requirements; it permitted sight glasses to be installed for viewing the strip properly at different stages of its travel through the furnace, and it will permit different atmospheres to be used in the several chambers should this ever be desirable.

Horace Drever: Dr. Stone has talked about the history, showing he is quite interested in the background of continuous strip annealing development, and I would like to add a few gaps that he did not quite fill. I can speak from first hand knowledge.

The first vertical furnace was installed in the Somers Brass Co. in Waterbury, Conn., in 1928. The objectives of that furnace were three. One was to produce a flat strip. The second was to produce a full finished, very thin strip, free from scratches. And the third was to conserve floor space. In that first small furnace those three objectives were completely met. It was the first time full finished—and by that I mean very finely rolled strip—was continuously annealed and produced scratch-free and flat. I might mention that the strip processed in that furnace was a maximum of 0.005 in. thick and graded down from that to .00075 in. That first furnace was followed by a second, and then a third.

Up until 1935, about 20 furnaces of the vertical type were built and successfully operated on various kinds of strip. In 1935, Crown Cork at Baltimore installed its first full width tinplate strip furnace, which was built by a company that I was then associated with, and another who were the first to work out the successful handling and recoiling of very soft tinplate or low carbon strip. Under the energetic leadership and initiative of E. J. Seabold that furnace was made a complete success and it repeated what had happened in 1928. It produced a scratch-free, flat, fully annealed strip, as fully annealed was understood, with a minimum usage of floor space. Following that two more furnaces were installed at Crown Cork for tinplate strip, and ranged in speed up to 350 fpm.

Because Crown Cork consumed its own product the steel industry was skeptical, and would pay no attention.

In 1941, as D. A. McArthur mentioned, the first radiant tube gas-fired furnace was installed at the Niles plant to anneal low carbon tinplate strip. The results we obtained there were precisely what are now being obtained at Dominion Foundries, at the Wheeling Steel Corp., and at the latest installation at Gary.

I would like to emphasize that 17 years ago the original principles in the annealing of low carbon tinplate strip were laid down, and except in the matter of degree they are being followed exactly today.

I would like to got out on a limb a little bit and make a prediction. Several years ago we proposed a furnace to some of the steel makers running at 1,000 fpm. We have seen the realization of that. I believe that in a few years from now we will all think 1,000 fpm for ordinary tinplate strip is slow.

Emil Kern: It may be of some interest to hear what you have to do when you have to shut this furnace down. Also from an operator's point of view, it may be interesting to hear about protective devices, in case of strip breakage, power failure, water failure, and so on. I believe on a large production unit like this many things have to be resorted to which normally one will not find in simpler installations.

M. D. Stone and **E. A. Randich:** The feature of the double deflector rolls in the heating zone being slowly rotated in opposite directions during shut down is indeed unique, and has worked out very well.

In Mr. Keller's remarks, he states the Rohn furnace in Germany antidated the Crown Cork line in this country. Our statement is that the Crown line was the first commercial tinplate annealing line. As to continuous annealing lines for other products, such as autobody sheets, wire, copper products, and the like—there are many earlier installations, such as the one at Ford, Armco, and others referred to in the bibliography. Mr. Keller's reference to the prepublications of a continuous tinplate annealing line at the Niles plant of Republic Steel Co. indicate once more that developments can be premature. The idea of a continuous process, including uncoiling and recoiling zones, was already established in the continuous electrolytic tinning lines of 1936. The idea of a tower type gas-fired annealer was of course a good one—but the fact that the line was discontinued shortly after going into operation bears closer scrutiny. Firstly, the proper annealing cycle of holding at temperature for the proper minimum time, and slow cooling at a predetermined rate, followed by a fast cool was not adequately appreciated. And secondly, the economics of the line were not attractive enough, as integral electrolytic cleaning in conjunction with high speed processing was not designed into the line.

Mr. Keller's question as to whether continuous annealing will replace coil annealing is treated in the paper in considerable detail. Based on conventional tests for tinplate, using hardness ranges, T-1 and T-2 are not obtainable on the continuous line. But the fineness of the grain of the continuous product as compared to the coil annealed product may well offset its lack of minimum hardness as far as drawing qualities are concerned. As to roll pickup, by proper advance selection of the roll material at the various temperatures, no problem was encountered. No doctor blades were ever found necessary, even experimentally. As to strip guiding, this may be said to have been the major source of concern for high speed operation—and the success in eliminating this source of trouble may be attested by the fact that this 30 ton per hr maximum capacity line has produced 24 tons per hr average over a month's time—an 80 per cent performance figure against all types of delay and operational interferences. As to hardness variation across the strip width and along the strip length, this may be said to be one of its major points of superiority over the product annealed in coil form, where inadvertent variations are an inherent shortcoming of the process. Hardness variations of a point or so are usual, except where variations in analysis lead to greater fluctuations. As to operational flexibility in handling width and gauge changes, width offers no difficulties whatsoever, and thickness changes must be properly scheduled so the line is slowed down for the heavier gauges.

As to Mr. Drever's comments, the authors wish to thank him for adding some early history in the nonferrous field that apparently antidated the ferrous field —but as we know it, the furnaces were very slow, and involved neither the more involved thermal cycle that tinplate must necessarily have, nor were the mechanical strip handling problems of any magnitude compared to those encountered in the high speed tinplate operation.

MODERN LIGHTING SYSTEMS FOR STEEL MILLS

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. . . . good, adequate lighting can increase efficiency of plant operations . . . .

▲ GOOD lighting for the various phases of steelmaking presents a real challenge. For example, the accumulation of dust and dirt on lighting equipment becomes a prime problem, the variation in seeing tasks calls for individual solutions in many cases, and the high mounting of equipment introduces considerations for features not generally encountered in the majority of installations.

Lighting is recognized as an essential tool of production and a safeguard against accidents. In numerous locations where data relating lighting to plant safety and production were obtained, a positive correlation was invariably discovered. Because of these and other benefits together with lighting research, the illuminating engineer, who forty years ago recommended 3 footcandles for offices and machine shops, is today being asked by consumers to specify 50 footcandles for these same areas.

The choice of a lighting system for a particular area depends not only upon the illumination level desired, but also upon such factors as mounting height, maintenance problems, building dimensions, burning hours per day, reflection characteristics of building surfaces, and perhaps most important, the visual tasks performed in the area.

In designing a lighting system, the seeing requirements of the workers should be analyzed for each type of task involved. Since all visual tasks are not equally critical, the level of illumination recommended varies with the degree of detail involved. For example, Table I shows the relative amount of light required by some industrial tasks for equal visibility. Table I may explain, in part, the relatively low levels of illumination generally found in steel mills. Many of the visual tasks involve rough operations requiring no discrimination of detail and involving the handling of only bulky materials. However, there are some areas in iron and steel mills, such as inspection operations, which require accurate visual perception. Areas of this type probably offer the greatest potentiality for improving production and safety through better lighting. The illumination levels currently being recommended for various operations are as shown in Table II.

TABLE I

Relative Amount of Light Required for Equal Visibility of Industrial Tasks

	Footcandles
Medium grade assembly and inspection	6
Metal buffing	8
Metal finishing — surface grinding	17
Fine sanding and finishing	22
Distinguishing black thread on black cloth	42
Precision die making	70

Reference: Reader's Digest requires 1 unit of light.

Industry's demand for filament lamps today is chiefly restricted to the higher wattage lamps — 750, 1000, and 1500 watt. These are usually used at the higher mounting heights exceeding 20 feet. Such systems are quite prevalent in the steel industry. Low initial cost and

TABLE II

Minimum Maintained Illumination Levels Recommended for Iron and Steel Processing

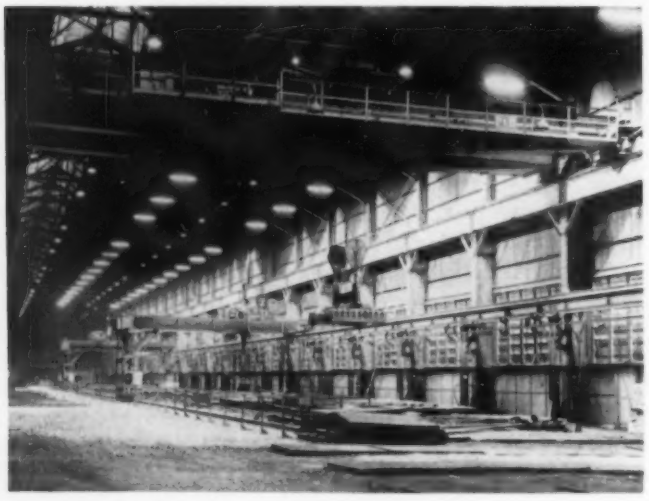
	Footcandles
Billet, blooming, sheet bar, skelp and slabbing mills	10
Boiler room, power house, foundry and furnace rooms	10
Hot sheet and hot strip mills	10
Cold strip, pipe, rail, rod, tube, universal plate and wire drawing	10
Merchant and sheared plate mills	20
Tin plate mills —	
Hot strip rolling and tinning machine dept.	10
Cold strip rolling	20
Inspection —	
Black plate, bloom and billet chipping	30
Tin plate and other bright surfaces	50
Machine shops and maintenance dept.	
Repair shops —	
Rough bench and machine work	20
Medium bench and machine work	50
Fine work — buffing, polishing, etc.	100
Extra fine work	300
Forging	30
Laboratories (chemical and physical)	30
Storage	5

electrical simplicity are the main advantages of this type of lighting.

On the other hand by providing twice the efficiency of filament lamps, the 400-watt mercury lamp, known as the A1, was immediately accepted in the steel industry after its introduction in 1934. Because of its greater efficiency and also predominantly blue-green radiation rather than red and infrared, regular mercury lamps produce one-fifth the apparent heat per footcandle as do filament lamps. A more recent development of this 400-watt mercury line is 33 per cent more efficient than the A1 — known as the E1 lamp. Another mercury lamp, entirely different in character, is the 3000-watt A9. This lamp which is 55 in. long and less than 1¼ in. in diameter, gives more light than 50 forty-watt fluorescent lamps. Since it delivers the biggest "package" of light of any industrial lighting lamp, it requires a minimum of lamps and equipment for a given illumination.

Five new mercury lamps have recently been made available. For areas where the 3000-watt A9 would be spaced so far apart as to produce non-uniform illumination, the 1000-watt A15 might be used. This lamp is also more efficient than the A9. A few months ago the H400-R1 reflector lamp was introduced. This lamp uses the E1 arc tube with an enclosed reflector in an R-52 bulb shape. In a few specialized areas where color is needed one of the new so-called color-improved mercury lamps may be used. These contain a phosphor inside the bulb to improve color rendition by adding a red component to the light output. The three color improved lamps are the: 1. 400-watt J1, a companion of the E1, 2. 400-watt RC1 with an enclosed reflector in an R52 bulb, and the 1000-watt C15 which is a companion of the 1000-watt A15 lamp.

Figure 1 — A combination mercury-filament lighting system is used at Geneva Steel Co., Geneva, Utah.



All mercury lamps have the disadvantage of remaining out after a power interruption or a momentary low voltage. A few minutes is required before the arc tube cools sufficiently to restart the arc. This is one reason why combination systems using both mercury and filament have become quite popular (Figure 1). In addition to the added safety over a straight mercury system which requires restarting time, this system provides a good color rendition by combining the red of the filament lamps with the blue-green from the mercury.

In certain steel mill tasks where the source brightness is particularly important, fluorescent lamps may be used. Most fluorescent lamps are large physically and produce a relatively low light output per foot. As a result, compared with mercury lamps, the brightness of fluorescent is less than 1 per cent. This low lamp brightness permits its use at almost any mounting height. In most existing fluorescent installations, either the 40-watt or 85-watt preheat lamp is used.

Today, more *new* installations are equipped with the 96T12 slimline than any other fluorescent lamp. Its overall cost is usually equivalent to that of a 40-watt preheat installation. The 96T12 lamp is 8 ft long, 1½ in. in diameter. Because of its length only half as many lamps are needed for the same installation and in addition this 96T12 instant start lamp is more efficient than the 40-watt preheat. As is the case with all instant start lamps, no starters are required for operation of the 96T12.

Many critical processes in the steel industry cannot be lighted economically and adequately with a general lighting system. For these specialized applications, one of the many types of supplementary lighting equipment may provide the additional quantity or directional characteristics needed to permit efficient seeing. The lower wattage filament and fluorescent lamps are usually used in these applications. It should be emphasized, however, that supplementary lighting alone cannot take the place of a good general lighting system.

MAINTENANCE OF LIGHTING SYSTEMS

A problem as important as maintenance has received, quite naturally, considerable attention in lighting design. The emphasis toward designing lighting equipment for better maintenance as well as more systematic methods of maintaining the illumination in the plant, is today greater than ever. The objective is to provide a higher average level of illumination while simultaneously reducing the man-hours required to maintain a lighting system. The maintenance problem may be divided into two parts: depreciation of light output and lamp replacement labor costs. Depreciation may be subdivided into

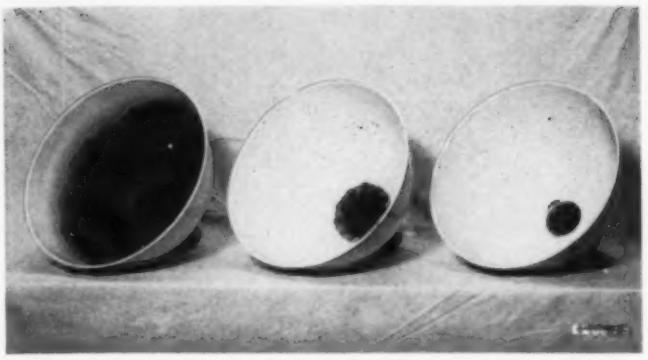


Figure 2 — Ventilation is an important factor on dirt collection in reflectors.

depreciation due to dirt on lamps and reflectors, and the reduction in light output of lamps themselves throughout life. Although loss due to dirt is usually much more severe, the decrease in light output due to both factors frequently exceeds 50 per cent. A certain amount of depreciation within a lamp is inherent, but lamp manufacturers are constantly striving to reduce this factor. The ordinary means of reducing the depreciation due to dirt is, of course, washing the lamps and reflectors. In some instances, the overall cost of light reaches a minimum when the lighting system is cleaned every two months. Some of the expense and inconvenience of cleaning can be eliminated by designing the lamps and reflectors for better maintenance. For some time so-called "dust-tight" lighting fixtures have been commercially available. Recent tests have shown that properly designed ventilating holes can reduce significantly the collection of dirt on reflectors. The heat from the lamp helps develop convection currents which carry much of the atmospheric dust up and out the ventilating holes. Figure 2 shows the reflectors used in such a test. This "chimney" action is not confined to the high wattage mercury and filament lamps. A similar test has shown that properly designed ventilating holes in fluorescent equipment will also tend to reduce dirt collection although to a somewhat lesser extent as would be expected due to the lower wattages involved. This effect of ventilation has influenced the design of many new industrial lighting units.

To meet a demand from industry for lighting with a lower rate of depreciation due to dirt, the high bay reflector lamp, Figure 3, was introduced about two years ago. This lamp has a built-in silvered reflector which is completely protected against the ill-effects of dirt. Since the face of the bulb is the only place where dirt may affect light output, depreciation due to dirt exceeds five per cent. First introduced in the 500 and 750-watt filament sizes, the same advantages are now available in the H400R1 and H400RC1 mercury lamps previously mentioned. The R52 lamps have gained wide acceptance in the steel industry and in other operations where dust and dirt is particularly severe. The R52 bulb is not heat resistant. Consequently, in areas where moisture may strike the bulb, the use of a protective shield is recommended. These high bay reflector lamps have frequently been used in older lighting equipment which has been corroded due to action of the elements.

The replacement of burned out lamps is obviously a universal lighting maintenance problem. It appears that a conservative estimate for the average time required to replace an individual burned out lamp in steel mills would be ⅓ to ½ man-hr. With the present cost of labor this time represents a significant portion of the overall lighting costs. As is often the case in industry, the investment in a labor saving device frequently reduces the overall cost. One such device for aiding lamp replacement is a disconnecting hanger. This device enables the lighting unit to be lowered to the floor where it may be easily serviced. Another effective "device" for reducing lamp replacement labor cost is known as simplified or group replacement. The plan involves the changing of all lamps at one time — mass production style — just *before* most of the lamps are expected to burn out. To be economical, a group replacement schedule must save more by reducing labor costs than the added lamp cost involved. Although this depends largely upon the particular costs involved, generally speaking, group replacement of fluorescent is almost always economical; group replacement of filament is usually economical; and a group replacement of mercury lamps usually not economical.

LIGHTING FOR COMFORT IN INDUSTRY

There is a great trend in industrial lighting today toward the creation of a comfortable visual environment. While the elimination of direct and reflected glare has long been the goal of lighting engineers, with today's higher lighting levels the problem becomes even

Figure 3 — The high bay reflector lamp is protected against ill effects of dirt.

Figure 4 — Sixty footcandles of quality illumination are used in this small finishing rolling mill at Metals & Controls Corp.

Figure 5 — Fluorescent louvered lighting equipment contributes 40 per cent upward light at Metals & Controls Corp. Mounting height is 22 feet.

more acute. By neglecting to apply all the principles that comprise a comfortable working environment, we reach a virtual ceiling regarding the benefit of lighting. For example, with conventional industrial lighting equipment, the factory worker may become uncomfortable under 100 footcandles of illumination — yet, many critical visual tasks require considerably more for good seeing. One may experience discomfort at the higher illumination levels, not because there is too much light, but rather because of the improved visibility, our eyes become more and more critical of brightness differences in the field of view. If these brightness relationships continue to be ignored as the footcandle levels are increased, the advantage of greater ability to see detail may be offset by the decline in visual comfort.

Accordingly, persistent demands for improved comfort in industrial lighting have been apparent during the last two years. A few progressive companies experimented with the use of modern office-type lighting equipment in the factory areas. One company in Massachusetts, tried such an experiment in a small finished rolling mill, Figure 4. The resulting seeing conditions were so far beyond any experienced before in their industrial areas that the same lighting design was adopted throughout the plant.

It is apparent from Figure 5, that even with a relatively high ceiling, the same comfort can be obtained.

If the entire visual surrounding is to provide a comfortable environment, it is of course, necessary to consider the finishes throughout the plant area. To utilize the output of the lighting equipment comfortably, as well as efficiently, the entire surroundings should be finished in light colors. Current recommendations include white ceilings, upper side walls reflecting about two-thirds of the light and everything below eye level reflecting at least one-third of the light. Figure 6 shows an installation of the newer type industrial lighting equipment in the foreground while showing part of the older section of the plant with the conventional industrial lighting equipment in the background. The actual lighting level in the new area is approximately 70 footcandles while that in the older area is about 50 footcandles. The improved visual effectiveness of the new type installation is great enough to warrant a marked change in industrial lighting practice in the immediate future.

Many lighting fixture manufacturers have made available, during the last few months, equipment specifically designed to provide the type of comfortable lighting required, together with rugged construction for industrial service. This equipment generally provides 25 to 35 degree shielding with about 25 per cent upward light, and white or luminous sides. This revolutionary movement in industrial lighting will ultimately bring to most factory workers the visibility and comfort that have previously been available to office workers and school children.

Every lighting system should be designed for the specific seeing task involved. Modern lighting systems for steel mills include almost every facet of lighting design due to the large range of visual requirements found in the iron and steel industry. In the first analysis the choice of a lighting system is based on economy. Special considerations such as maintenance or visual comfort are directly, or indirectly related to the economics involved.

Greater production output and decreased spoilage and accidents are direct benefits experienced through

Figure 6 — New quality industrial lighting system contrasts with conventional equipment in background.

most good lighting installations. The indirect economies include better housekeeping, less eyestrain, and improved employee morale. A well designed lighting system is beneficial to management and labor alike. But a good lighting system must have a good power system to supply the power; otherwise the investment in the lighting system may not be utilized to best advantage.

POWER DISTRIBUTION SYSTEMS FOR SUPPLYING THE LIGHTING LOAD

One opportunity for making a better lower-cost overall installation is afforded when gaseous discharge lamps (i.e. mercury or fluorescent) are used.

All gaseous discharge lamps have a ballast in series with them. In general, these ballasts have a transformer action designed in them to step the usual 120-volt supply voltage up to some higher voltage for operation of the lamps. By changing the turn ratio of the transformer section of these ballasts, they can be designed to operate equally well on 120 volts, 208 volts, 240 volts, 277 volts, and in some cases even 480 or 600 volts. The fact that these gaseous discharge lamp ballasts can be designed for higher than 120 volts eliminates the 120-volt restriction imposed by incandescent lamps. The fact that satisfactory higher voltage incandescent lamps were not designed has limited lighting circuits almost universally to 120 volts. But with this limitation

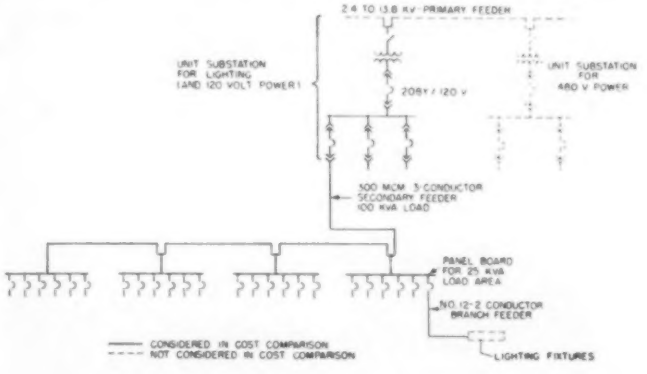

2.4 TO 13.8 KV PRIMARY FEEDER
UNIT SUBSTATION FOR LIGHTING AND 120 VOLT POWER
208Y / 120 V
UNIT SUBSTATION FOR 480 V POWER
500 MCM 3 CONDUCTOR SECONDARY FEEDER 100 KVA LOAD
PANEL BOARD FOR 25 KVA LOAD AREA
NO. 12-2 CONDUCTOR BRANCH FEEDER
CONSIDERED IN COST COMPARISON
NOT CONSIDERED IN COST COMPARISON
LIGHTING FIXTURES

Figure 7 — Power system uses separate substations for lighting and power loads.

of 120 volts removed, when gaseous discharge lamps are used, it is now feasible to use higher voltage distribution systems for supplying the lighting load and save considerable money. It should be clearly borne in mind that higher voltages are recommended only for the gaseous discharge lamps and not for incandescent lamps.

There are certain restrictions as to where higher voltage lighting distribution systems should be used for supplying fluorescent or mercury vapor lamp ballast. First of all, the Code restricts the application of lighting fixtures supplied at higher than 150 volts to ground to being located not less than 8 feet from the floor and to not have an individual switch in each lighting fixture. Therefore, the main concern is with general area lighting as is illustrated in Figures 4, 5, and 6. These illustrations show fluorescent lamps, but in many others, and in particular in steel mills, these may quite often be mercury lamps rather than fluorescent.

COMPARISON OF POWER DISTRIBUTION SYSTEMS FOR SUPPLYING LIGHTS

There are three rather basic methods of schemes of power distribution for supplying the lighting load. These three schemes are described and compared below. The system referred to in Figure 7, which will be identified in System A, consists of separate substations for supplying the lighting and low voltage power load. In this case the lighting substation secondary voltage has been assumed to be 208Y/120 volts supplying the lighting fixtures at 120 volts. This system was quite commonly used a number of years ago but is used less and less in

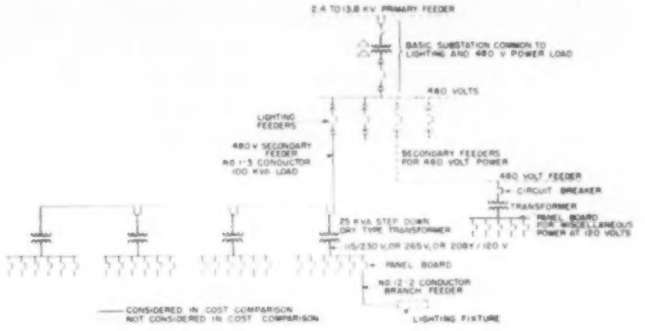

2.4 TO 13.8 KV PRIMARY FEEDER
BASIC SUBSTATION COMMON TO LIGHTING AND 480 V POWER LOAD
480 VOLTS
LIGHTING FEEDERS
480 V SECONDARY FEEDER NO. 1-3 CONDUCTOR 100 KVA LOAD
SECONDARY FEEDERS FOR 480 VOLT POWER
480 VOLT FEEDER
CIRCUIT BREAKER
TRANSFORMER
PANEL BOARD FOR MISCELLANEOUS POWER AT 120 VOLTS
25 KVA STEP DOWN DRY TYPE TRANSFORMER
115/230 V, OR 265 V, OR 208Y / 120 V
PANEL BOARD
NO. 12-2 CONDUCTOR BRANCH FEEDER
CONSIDERED IN COST COMPARISON
NOT CONSIDERED IN COST COMPARISON
LIGHTING FIXTURE

Figure 8 — Power system with combined light and power substation. Small transformers are used for supplying 120-volt lighting load.

modern industrial plants. The system of Figure 7 can be simplified and its costs reduced by going to a combined light and power substation as shown in Figure 8. This will be identified as System B and is characterized by combined light and power substation stepping all power down to 480 volts and then stepping the lighting power down from 480 volts to 120 volts through small dry type transformers and supplying the lighting fixtures at 120 volts. In this example a 1000-kva substation might be used instead of a 300-kva lighting

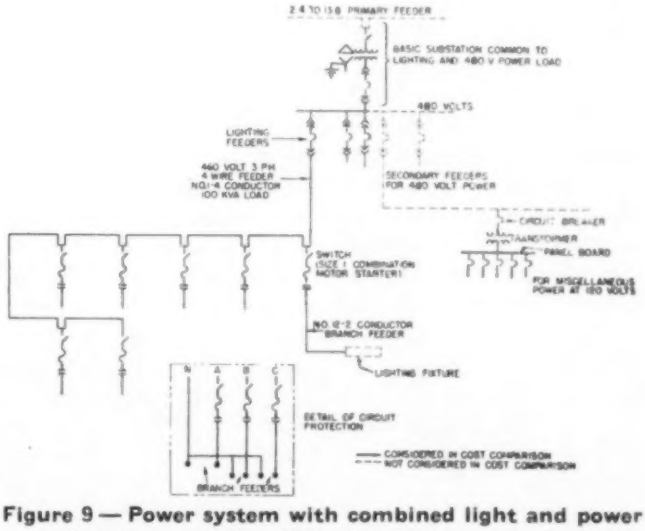

2.4 TO 13.8 PRIMARY FEEDER
BASIC SUBSTATION COMMON TO LIGHTING AND 480 V POWER LOAD
480 VOLTS
LIGHTING FEEDERS
480 VOLT 3 PH 4 WIRE FEEDER NO. 1-4 CONDUCTOR 100 KVA LOAD
SECONDARY FEEDERS FOR 480 VOLT POWER
CIRCUIT BREAKER
TRANSFORMER
PANEL BOARD
FOR MISCELLANEOUS POWER AT 120 VOLTS
SWITCH (SIZE 1 COMBINATION MOTOR STARTER)
NO. 12-2 CONDUCTOR BRANCH FEEDER
LIGHTING FIXTURE
DETAIL OF CIRCUIT PROTECTION
BRANCH FEEDERS
CONSIDERED IN COST COMPARISON
NOT CONSIDERED IN COST COMPARISON

Figure 9 — Power system with combined light and power substation supplies 277 volts for gaseous discharge lamp ballasts.

substation and a 750-kva power substation for System A, Figure 7.

The third and lowest cost system is that shown in Figure 9, which will be identified as System C. Like

System B, this has a combined light and power substation stepping all power down to 480 volts. This substation, however, has a wye-connected grounded neutral, 480-volt secondary, and the lighting fixtures are supplied directly from the 480-volt system using the line-to-neutral voltage — that is, 277 volts in this case — to supply the gaseous discharge lamp ballast. The 277 volts was selected because there was a requirement on the part of the National Electrical Code to keep the voltage on the lighting fixtures to less than 300 volts to ground. The major difference between System B and System C is that in System C the second transformation from 480 to 120 volts is eliminated for most of the lighting load. There will, of course, be some incandescent lamps, desk lamps, etc., which will have to be operated at 120 volts, and these will be supplied through a 480 to 120 volt step-down transformer as shown to the right of Figure 9. In System C, Figure 9, the control of the lighting circuits can be either panelboards or combination motor starters. More will be said about that later.

When the costs of Systems A, B and C are compared, it is necessary to compare all elements between the primary feeder and the terminals of the lighting fixtures. On this basis, System A — that is, the system having separate lighting and power substations and supplying 120 volts to the lighting fixtures — costs $82 per kva of lighting load. System B, which has a combined light and power substation and supplies 120 volts through small step-down transformers to the lighting fixtures, costs $59.50 per kva of lighting load. This includes the lighting load's share of the cost of the transformer and the main secondary breaker of the unit substation. System C, which has a combined light and power substation and a 3-phase, 4-wire, 480Y/277 volt feeder for supplying the higher voltage fluorescent and mercury vapor ballasts, costs only $46.75 per kva of lighting load. Again, this includes the lighting system's share of the cost of the unit substation, transformer, and main secondary breaker. System C costs only a little more than half as much as System A and it is about 20 per cent cheaper per kva than System B. These figures have been established in many actual jobs. In the author's own company, the higher voltage lighting system — that is System C — has been used for over 8 years with outstanding results. It can safely be said from this experience and from the experience of other operators that, providing the proper protection and switching means are afforded for the high voltage lighting circuits, there are no difficulties inherent in the system because higher voltage is used.

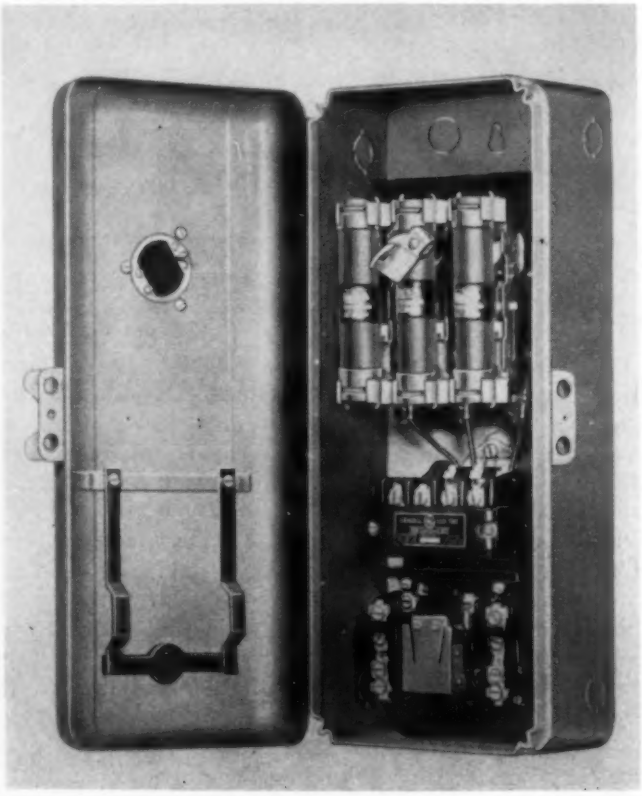
The cost of the lighting fixtures may vary slightly as a function of voltage. In general, the mercury vapor lighting fixtures are the same price regardless of whether the ballast voltage is 120 or 277 volts. In fluorescent fixtures, some may cost more at 277 volts and others may cost less at that voltage. However, in any case, the difference is so small as not to materially affect the overall economics. As a matter of interest, the additional cost per fluorescent lighting fixture would have to be of the order of $2 to $3 per fixture to offset the savings in the higher voltage distribution system.

Higher voltage ballasts for fluorescent lamps of the types and ratings commonly used for general area lighting are readily available from major manufacturers. The same is true with 277 volt ballasts for the 400-watt mercury lamps. The larger mercury lamps — that is the 1-kw and 3-kw units — can be operated directly from 480 volts and therefore they may be operated at the higher voltage in any of the systems described previously.

SWITCHING AND PROTECTING HIGHER VOLTAGE LIGHTING CIRCUITS

The higher voltage lighting circuits operated directly off a 480-volt power system must be adequately protected and must have adequate switching means. Two factors make this important. The first and most important is that 480 volts is more difficult to switch and handle in a switching device than is 120 volts. It is very difficult, if not practically impossible, to make 120 volts restrike whereas 480 volts will. Therefore, a better interrupter from a voltage standpoint is required. The second point is that the lighting circuits now come off the power systems and short-circuit currents may be relatively high because of the larger substations employed in the power system. As stated previously, either panelboards or fused combination motor starters can be used for protecting and switching the 277-volt lighting circuits. Panelboards, however, have very definite limitations, particularly if they are circuit breaker panelboards. In general, they are limited to 10,000 amperes interrupting rating, which is not adequate for most power systems, and secondly, the circuit breakers are not current limiting and therefore may not open the circuit fast enough to prevent damage to the small wire (No. 12 B&S gage) generally used in

Figure 10 — Combination motor starter has current-limiting fuses for controlling 277-volt lighting circuits.



lighting circuits. A more satisfactory and a somewhat lower cost method of protecting and controlling these lighting circuits is to use a Size 1 combination motor starter with 20-amp silver-sand current limiting, high interrupting capacity fuses. A typical combination motor starter including current limiting fuses is shown in Figure 10. This overall combination has an interrupting rating of 50,000 amp, which makes it adequate to be connected to systems supplied by 480-volt transformers as large as 1500 kva. The current limiting fuses should be not larger than 20 amp, which are adequate for protecting No. 12 branch circuits. Fuses larger than 20 amp are not considered to give good enough protection to the ballast, particularly of fluorescent lamps. The 20-amp fuses are so current limiting that they will pass only a few thousand amperes peak current when the available current is as high as 50,000 amp. Therefore, these fuses act as a limiting device to keep the high short circuits on the power system off the lighting system. These combination motor starters are 3-pole devices and would switch three single-phase, 277-volt branch circuits. Using the branch circuits up to about

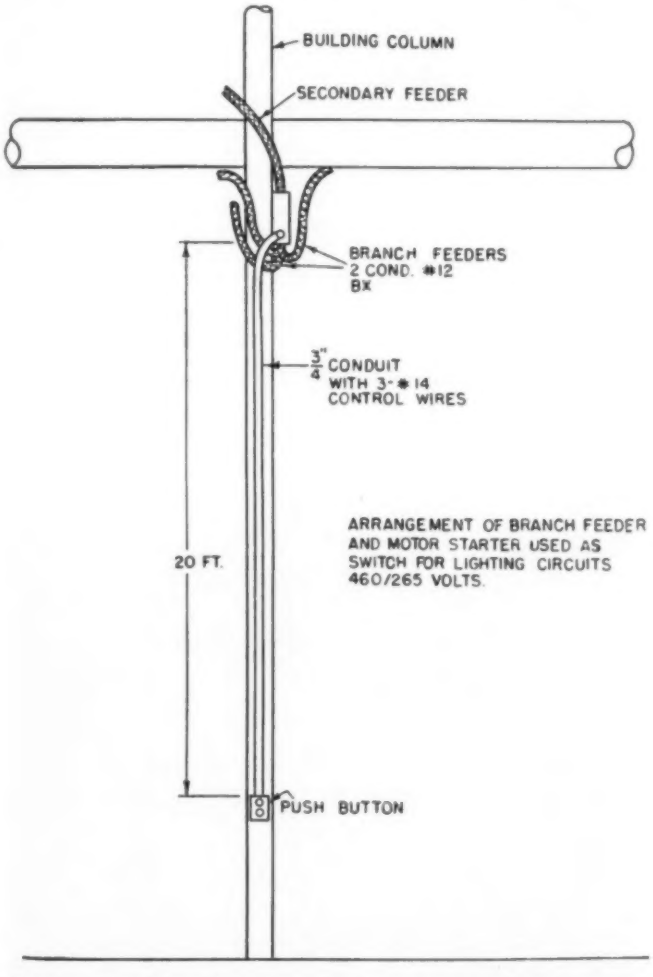


Figure 11 — Sketch shows motor starter for controlling lighting circuits mounted up near lighting fixture.

16 amp will enable switching a lighting load of approximately 14 kva. Since in most factories all general area lights are on all the time the factory is in operation, switching the lights in larger blocks is no economic handicap from that standpoint.

The motor starter for controlling the lighting circuits can be mounted up near the lighting fixtures as shown in Figure 11, and only the control circuit for the contactors runs down the column.

It is well to reemphasize the importance of adequate switching and protective means for these high voltage lighting circuits. The combination motor starter and current limiting higher interrupting capacity fuse just described adequately fulfill the requirements.

COMBINATIONS OF INCANDESCENT AND MERCURY LAMPS

Figure 12 is a summary of the methods of supplying various kinds of lights from a 480Y/277 volt system.

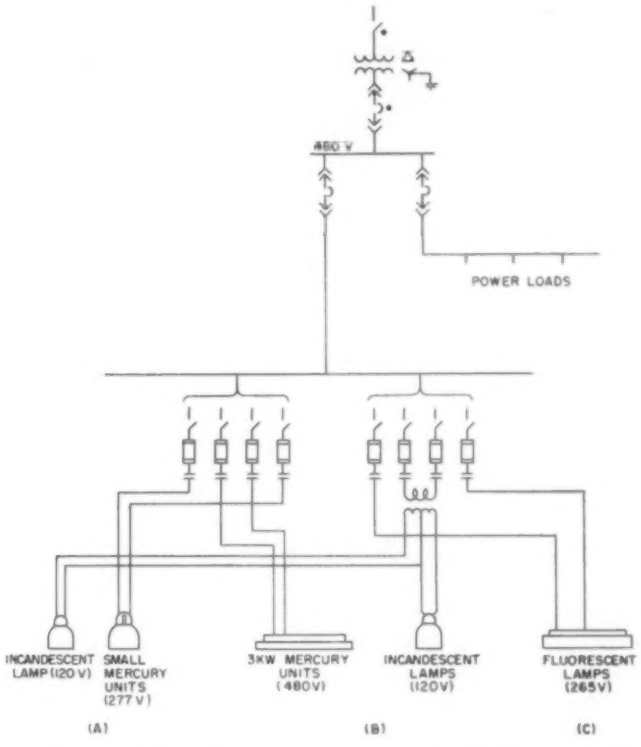


Figure 12 — Summary of methods of supplying various kinds of lights in a steel mill.

The incandescent lamps should be operated off 120-volt systems. Therefore, they will be supplied through a 480 to 120-volt transformer as shown in Figure 12. The small mercury units and fluorescent lamp units can be operated at 277 volts directly off the line-to-neutral voltage of the 480Y/277 volt power system. The kw and 3-kw mercury lamp units can be operated directly at 480 volts.

In steel mills or other industrial plants where the small mercury units are employed in combination with incandescent units, it will be more economical to run two branch circuit systems, one for 277 volts for the mercury units and another at 120 volts for the incandescent units.

VOLTAGE FLICKER

Voltage flicker due to fluctuation power loads will not cause objectionable light flicker for the average factory using a combined light and power system like Systems B and C. The same is true in steel mills. In steel mills

there may be larger motors which start frequently, which should not be connected to the same 480-volt bus that serves the lighting load. If there are any large resistance welders, they should be connected to a separate 480-volt bus. In a modern load center power distribution system where a number of substations are used instead of one very large one, it is normally very easy to segregate that load which would cause light flicker and the lighting circuits in such a way that the welders and other power that is not critical to flicker is placed on one bus, and the 480-volt power which will not produce light flicker plus the lights is put on another bus. Of course, any loads that are large enough to bump the primary system will cause flicker, regardless of where the lights are connected into the primary system.

RELIABILITY

It is generally considered best practice when using either Systems B or C to use separate 480-volt feeders for the lighting load. There are many more outages on the secondary power feeders than on the lighting feeders because of the greater number of changes made in the

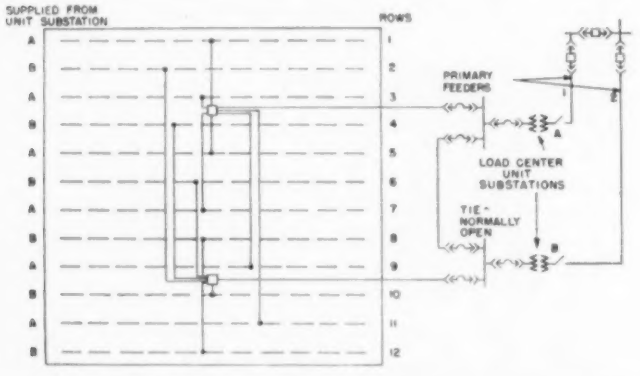
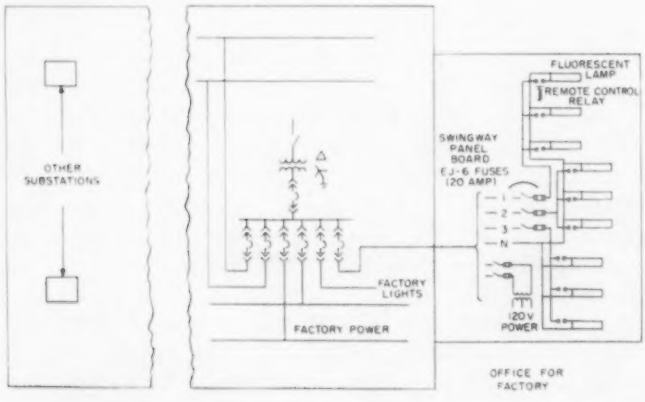


Figure 13 — Secondary selective system supplies combined light and power loads.

feeders. Furthermore, power feeders may have more voltage drop due to fluctuating loads.

Some have argued, however, that the separate lighting and power substations would further increase the reliability — in other words, that the segregation should

Figure 14 — Sketch shows method of supplying 277-volt fluorescent lighting load in an office area off one of the factory substations.



be carried back beyond the substation. Further review of this will indicate that by proper system design using load center systems with secondary selective arrangement, even better service reliability can be obtained in the combined light and power system than when separate power and lighting substations are used. When separate power and lighting substations are used, an outage of the light substation means an outage of all the lights. In the secondary selective system shown in Figure 13 there are two radial systems with a normally

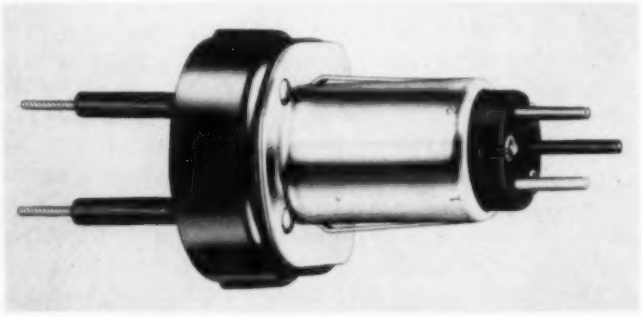


Figure 15 — Remote-control relay is used to switch 277-volt lighting circuits in an office building.

open tie between them. Should either system have a primary feeder or a transformer outage, the entire lighting load can be switched to the other substation and keep all lights on. A design of the secondary wiring system as shown in Figure 13 by placing alternate rows of lights from alternate substations will provide at least partial illumination even for the outage of the branch circuits. By proper system design, the combined light and power system can be made as reliable or even more reliable than systems using separate lighting substations and primary feeders.

Figure 16—View shows fused panelboards of type suitable for 277-volt branch circuit protection when using proper fuses.

FACTORY OFFICE POWER SUPPLY

All steel mills and other industrial plants have sizable office areas associated with them. Where these offices are lighted by fluorescent lights mounted more than 8 feet off the floor, they can be served at 277 volts to reduce the cost of the power distribution system supplying the office lighting area. If it is a relatively small office attached to a factory building, then the office area could be supplied off one of the 480Y/277 volt power substations in the factory area near the office section, as shown in Figure 14. In other areas where complete and separate office buildings are built, these could be supplied at 480Y/277 at a considerable saving over using 208Y/120 volts. A recent study indicated that a saving as much as $30 per kva in the total building system distribution cost could be saved.

The significant difference between the system for office buildings or office areas and factory areas is in the method of controlling the lighting branch circuits. While Size 1 motor starters are satisfactory for factory areas where the lights can be switched in large blocks, they would not be satisfactory for office areas. However, by using the recently introduced remote control wiring system, and again using the proper protection for the lighting circuit, the remote control relays can be substituted for the contactors in the office buildings. These remote control relays as shown in Figure 15 have 24-volt operating coils and contacts suitable for switching 277 volts, 10 amp. These relays are tested by the Underwriters' Laboratories for such applications. By mounting these relays up near the ceiling, it is only necessary to bring the 24-volt control circuits down to the wall switches; therefore, that obviates the necessity of having high voltage applied to the wall switches. Normally, wall switches are limited to a maximum of 250 volts. These remote control relays must again be protected by fast-acting current limiting silver-sand fuses. These may be used in fused panelboards such as the board shown in Figure 16. Tests have been made with a 20-amp silver-sand fuse in series with the contacts of the remote control relay on available short-circuit currents as high as 25,000 amperes. In such cases, the fuse acted fast enough to protect the contacts of the remote relay. Therefore, this system can be said to have adequate short-circuit protection. The higher voltage lighting system is now being applied to several office buildings.

DISCUSSION

PRESENTED BY

T. S. NOVAK, Assistant Electrical Engineer, Bethlehem Steel Co., Sparrows Point, Baltimore, Md.

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C. J. ENLIND, Contract and Control Engineer, United States Steel Corp., Pittsburgh, Pa.

S. EIN, Senior Electrical Engineer, Inland Steel Co., East Chicago, Ind.

R. F. VANDENBOOM, Illuminating Engineer, Lamp Div., General Electric Co., Nela Park, Cleveland, Ohio.

D. L. BEEMAN, Manager, Industrial Power Section, General Electric Co., Schenectady, N. Y.

T. S. Novak: Good lighting in a steel plant has a direct bearing on product quality, high productivity and safety. The authors pointed out that accumulation of dust and dirt on lighting equipment can depreciate the light output 50 per cent or more. It is essential that the output of an installed lighting system be kept to a maximum and this can only be done by having a regular schedule for periodic cleaning of the fixtures.

Not too long ago it was a general practice to clean lighting equipment only when burnt out lamps were replaced or when the operating people complained about not having enough light. Today we have a regular schedule to check and clean lighting equipment and this practice is an indispensable part of plant operations.

In the coke oven area where dirt and dust presents the greatest problem, we have men that spend their entire time cleaning lamps, globes and reflectors. On the average the outdoor equipment is cleaned once every two weeks. In this area it is not unusual to have the light output of some of the outdoor fixtures cut to 50 per cent in a period as short as 24 hours, especially if a rainy day occurs and the wind is blowing in the right direction.

In other areas of the plant, the checking and cleaning is done from 3 to 5 times a year depending upon the systems, hours of service and the amount and type of dust and dirt released by the operation. In these areas the reflectors of the dust tight fixtures are cleaned every check-up period whereas in the coke oven area, the bottom glass of the outdoor fixture is cleaned 4 to 5 times before the reflector requires cleaning.

It has been found that frequent cleaning of lighting equipment is the most economical method for obtaining high average light outputs of existing installed systems, especially if the lighting levels are 10 footcandles or more.

H. B. Elliott: Rather than present a general comment on the lighting application section of this paper, reference will be made to each individual paragraph in order to retain the same order of presentation of subject that was set up by Mr. VandenBoom. The following comments are given in that form for the purpose of easy reference to the original subject matter on lighting application.

In the second paragraph of Mr. VandenBoom's part of the paper, there is an implication of the need for 50 footcandles in steel mills through reference to changes in illumination levels for offices and machine shops over a period of 40 years. By inference it appears that 50 footcandles is recommended for work areas in steel mills by this reference to the need for higher levels of illumination in offices which are comparatively minor lighting problems in steel mill lighting application. Except for some inspection areas and other places where close tolerances must be observed, there is absolutely

no way of proving an economic need for 50 footcandles in steel mill lighting. A review of current lighting levels and present-day design of lighting systems in high bay locations in steel mill areas will reveal that the maintained levels of illumination are under 20 footcandles and in no case are there installations of 50 footcandles in general work areas. The levels of illumination shown in Tables I and II bear out this fact that 50 footcandles are decidedly higher than levels required in general work areas. The conclusion can be reached that reference to 50 footcandles in paragraph 2 is entirely out of place in discussing the problem of lighting application in steel mills.

All factors discussed in paragraph 3 on the choice of a lighting system for a particular area are correct as far as they are stated, but the most important factor of all, namely, the cost to own and operate a lighting system is not brought into this part of the paper. The true worth of any general lighting system for application in steel mills is measured by the lowest cost per footcandle per year to own and operate, based on a given period of amortization.

In paragraph 5 there is a reference to cost but the reference is to initial cost only, and there is no consideration of operating cost in this presentation of the subject of lighting application with regard to filament lamps in the range of 750, 1000 and 1500 watts.

In paragraph 6, where the first references are found relating to mercury vapor lamps, the emphasis seems to be on lumen ratings of light sources and not, as it properly should be, on the utilization of these potential lumens. For some high bay areas, it can be demonstrated, for example, that two 1000-watt mercury vapor lamps in reflectors of proper design can produce higher levels of illumination at the work plane than would be obtained from one 3000-watt mercury vapor lamp. Throughout the remainder of my comments emphasis will be placed on utilization of potential lumens and the economic side of lighting. These points in the discussion are presented from results of studies that have been made on the application of all types of lighting equipment to high bay areas in steel mills. While these studies have been applied to specific conditions, enough answers have been produced to permit generalizations of findings sufficiently broad to cover all of the lighting sources discussed in Mr. VandenBoom's part of the paper.

In paragraphs 7 and 8, there appear statements concerning the need for color improvement of mercury vapor lighting application in steel mills. So far as our experience is concerned, we have never seen a condition in steel mills where there was need for color corrected mercury vapor lighting, so that all references to this part of the subject seem to be out of place in this paper. Again, in paragraph 8, there is an attempt to justify combination incandescent-mercury vapor systems by attributing a quality to good color rendition when the fact is that combination systems are not desirable from an economic standpoint. In order to utilize the advantages of recently developed mercury vapor lamps in the 400 and 1000-watt sizes, designs should be made for basic mercury vapor lighting systems with minimum standby incandescent units to furnish low levels of illumination in case of voltage dips or power failure. Combination systems on equal outlet or equal lumen bases should not be recommended or installed because they do not take full advantage of the plus qualities of mercury vapor lighting application.

It is doubtful, except in some small inspection areas, whether source brightness is ever a disadvantage in lighting of steel mill areas as stated in paragraph 9. Mercury vapor lamps are mounted above crane rails in most steel mill areas and when they are installed in reflectors with proper distributions and proper cutoffs, there will be no complaint of source brightness from any men working in steel mills.

The statement in paragraph 9 that low lamp brightness permits the use of fluorescent equipment at almost any height is entirely misleading. It can be proved that the diffuse type distribution of standard fluorescent industrial reflectors are utterly inefficient at some of the mounting heights that are current in steel mill lighting today. Utilization of potential flux is still the criterion of good steel mill lighting, and the attempt to bring in a nonexistent quality, namely, low brightness of light source, is entirely out of place in discussing steel mill lighting problems.

Many of the subjects treated in paragraph 12 are presented as new findings of facts on reflector design. A point seems to have been missed here because it is known that properly designed reflectors with open bottoms and ventilated sockets have been available and have been installed in many steel mill areas over the past 35 years. It was no accident that these "ventilated" type reflectors have found wide acceptance in dirty locations such as foundries and similar areas.

Most of the statements in paragraph 13 should be backed up by test data especially those regarding the depreciation of neck silvered incandescent reflector lamps in the R-52 bulb shape. It is suggested that maintenance tests be conducted between groups of reflector lamps and properly designed industrial reflectors equipped with standard incandescent lamps and that complete data as to the test results be made available to prospective users of industrial lighting equipment. In theory, the story built around the design of the neck silvered reflector lamp is good to read, but the facts revealed by a comprehensive maintenance test will prove interesting to the prospective user of this type of lighting equipment. Even if the R-52 lamp had the quality of maintaining high output through life, which is subject to proof, the fact still remains that the utilization of potential lumens from this source on the basis of owning and operating a lighting system at lowest cost per footcandle is still too high to be considered for general area application in steel mill lighting systems. The cost of buying a new reflector and lamp at end of 1000 hours' life is too high in steel mills where the operating schedule today is 21 shifts per week or approximately 8400 hours per year.

The subjects covered in paragraph 15 and 16 are in the realm of theory at the present time and it is unfair to seek to prove a theory with regard to steel mill lighting by showing a small shop in Figure 4 where fixtures are mounted no more than 12 ft above the floor. This figure is not representative of steel mills as we know them today and the same statement can be made with regard to Figures 5 and 6. Actual conditions in steel mills are more fairly represented by the view in Figure 1 and there is a great difference between this photograph and the ones shown under Figures 4, 5, and 6.

In paragraph 19, there is another statement which declares that new fixture designs are available which provide some upward component of illumination. This type of equipment has been available for a number of years and, where the interior conditions are suitable, there have been many installations of industrial reflectors which provide some upward component. The fact is that upward component in industrial interiors is not a new lighting application, as seems to be indicated in paragraph 19, and at least some credit should be due to manufacturers who have provided this type of equipment for many years past.

The subject of economics as applied to a lighting system enters this paper in paragraph 20 but here it seems to have only secondary importance. It is logical to assume that owners and operators of steel mills look upon the purchase and use of any equipment from an economic standpoint and there is no reason why the economic aspects of various lighting systems should not be included in their studies of steel mill operations. Low first cost or the use of high output sources are not the measures of good lighting alone. It cannot be expressed too strongly that, all other considerations being equal, the best lighting system is the one that delivers maximum maintained footcandles at work planes for lowest annual owning and operating costs.

C. J. Enlind: Mr. VandenBoom's paper shows that much progress has been made in the last few years in the design of lamps and fixtures for industrial use; also in the method of distributing light.

From the operator's standpoint, it is believed that the basic requirements for steel mill lighting systems may be summed up in the following:

1. Well distributed light of sufficient intensity to meet the requirements of production and safety.
2. Lighting equipment should be designed so that it will require minimum attention and in most cases, no cleaning.
3. Provision should be made for lamp replacement with minimum interference to operations.

Referring to the distribution of light, this varies considerably and depends on the size of the area to be lighted, the uniformity of light required, intensity of light required, mounting height, etc. In some locations large mercury type fixtures, such as the 1000-w and 3000-w size can be used to advantage at wide spacing and meet all lighting requirements. In other locations, it may be necessary to use smaller fixtures, such as the 400-w size at close spacing to obtain the kind of lighting required.

Referring to the problem of keeping lighting reflectors clean in steel mills, this is a real problem. It does not take long to reduce the output of a lighting fixture as much as 30 to 50 per cent, because dirt accumulates rapidly on the non-ventilated type reflector. The ventilated type of reflector maintains a relatively high efficiency without the need of cleaning.

The new lamps referred to by Mr. VandenBoom, which have built-in reflectors are also a big improvement and provide a well sustained output of light without the need of cleaning.

Both the ventilated type reflector and the lamps having built-in reflectors should be of considerable value for use in foundries and steel mills.

Another improvement of interest to industry is the feasibility of using higher voltage distribution systems for supplying the lighting load for gaseous type lamps. This makes a considerable saving in copper.

With the aid of better lamps and fixtures developed in the last few years, it should be possible to provide better light in future installations without any appreciable increase in the initial cost. It is important to emphasize that all designers and manufacturers of industrial lighting equipment should keep the maintenance problem in mind at all times, so as to avoid unnecessary maintenance of lighting fixtures.

S. Ein: Despite the benefits to be gained from cleaning of fixtures as described in the article, many steel mills just do not have the manpower to devote to this use, and, therefore, the lighting system must be designed with this fact in mind. This can be accomplished by using, in some cases, a total value as low as 40 per cent for maintenance factor and coefficient of utilization. Of course, when the building and fixtures are new, there is an overabundance of light, but as dirt accumulates on the inside building surfaces and on the fixtures, the amount of light available decreases to a figure somewhere near the design value.

Because of lack of maintenance, dust tight fixtures do not have all of the benefits described. With a dirty cover, the fixture will produce less light than an open fixture which is also dirty. For this reason, open fixtures in mill areas are the better solution.

The benefits of very good lighting cannot be denied, but in an existing mill, when the lighting intensities in a new location are higher than those present in the older places, there may be pressure to increase the older lighting to that of the new installation despite the fact that the older lighting has been adequate for many years. As the result, the investment cost will rise because of the required increased transformer and line capacities without being able to justify the increased costs. Some increased intensity is warranted on the bases pointed out in the article, but it is best to increase the intensities at only small percentages in new locations.

A good part of the article is devoted to fabricating shops. However, a large part of steel mill lighting is applied to structures and buildings devoted to blast furnaces, open hearths, and rolling mills where light colored ceilings and walls are nearly impossible to attain, and where extremely high bay lighting is required. A practical solution must take these situations into account along with the almost universal condition of being unable to secure adequate maintenance as previously stated.

The points made for high voltage lighting and remotely controlled switching means have considerable merit and are being increasingly used in the newly built areas of many steel mills and other plants.

R. F. VandenBoom and **D. L. Beeman:** We are grateful to Messrs. Enlind, Ein and Novak for their valuable comments.

The more pertinent of Mr. Elliott's comments will be discussed in the order of their presentation.

We regret that Mr. Elliott has mistaken the reference to footcandle recommendations in office and machine shops for those in steel mills. As shown in Table II, the specific recommendations for the bulk of the tasks in the iron and steel industry fall in the 10 to 20 footcandle region.

The overall cost is, of course, a major factor in choosing a lighting system. I am sure Mr. Elliott does not mean in his statement that the true worth of a lighting system is only measured by the lowest cost per foot-candle. He must be assuming that lighting quality and the resultant visual comfort is equivalent in the systems being considered. We all admit that overall visual comfort has not had the attention it deserves in steel mills — usually for reasons of economy. Mr. Elliott, no doubt, subscribes to the idea that comfortable lighting has considerable value.

In listing the advantages of using filament lighting, operating cost was not mentioned since it is higher, generally, than either mercury or fluorescent lighting. Hence, the higher operating cost is a disadvantage.

It was our intention to discuss various mercury lamps that have application in steel mills. No reference was made to relatively utilization or economics. In most cases the 3-kw mercury provides lighting at lower cost than the 1000-w.

Mr. Elliott seems to have missed "In a few specialized areas where color is needed . . . . ". Undoubtedly, the people in the steel industry are looking for ways to improve their lighting and are not entirely satisfied by part practice. It seemed desirable to bring to their attention examples of improved conditions.

The effect of luminaire mounting height on the utilization of a lighting system is often misunderstood. I am sure Mr. Elliott realizes that the percentage of luminaire output utilized is dependent upon the ratio of mounting height of lighting equipment to building length and width, and not upon mounting height alone. For example, the coefficient of utilization in a 20 × 40 ft plant with a 10 ft mounting height is exactly the same as in an area 100 × 200 ft with a 50 ft mounting height. Consequently, in certain high ceiling industrial areas it has been found that fluorescent fixtures can provide a lower overall cost than a combination mercury-filament system. In some instances, higher luminaire and lamp efficiency more than offset the higher coefficient of utilization generally found with concentrating-type mercury and filament reflectors.

We pointed out that "the emphasis toward designing lighting equipment for better maintenance . . . is today greater than ever." The impetus for this activity has been influenced by recent tests.

Extensive maintenance tests have been conducted on the R-52 reflector lamps as well as other types of lighting equipment. For example, five 750-w reflector lamps were placed on 3-ft centers in a welding shop at a mounting height of approximately 50 ft. After seven months exposure, or 1200 burning hours (incidentally, the rated life of a reflector lamp is 2000 hours), the dirt on the lamps decreased the light output by 3 per cent. Meanwhile in the same area, a typical unventilated "high-bay" unit for a 1000-w lamp depreciated 26 per cent in the same period.

Mr. Elliott points out equipment with up light has been available for some time. This would tend to refute his further statement that this type of installation is just a theory. Certainly the importance of improved comfort in steel mills has not been recognized as much as in other industries with similar problems. It seemed essential to point out to steel men the benefits of better and more comfortable seeing conditions which have been so well verified by others.

YOUNGSTOWN DISTRICT SECTION FORMED

As a result of the growth of the AISE, the board decided to form a new independent section of the Youngstown, Ohio, group, which previously had been associated with the Cleveland section. John L. Young, president of the AISE, appointed the following officers shown left to right: W. W. Justice, superintendent operating maintenance, U. S. Steel Corp., Youngstown, Ohio—vice chairman; Jay F. Hall, manager, Harry J. Fisher Associates, Poland, Ohio—secretary; J. A. Ferguson, electrical engineer, Republic Steel Corp., Youngstown, Ohio—chairman. Members appointed to the executive committee are: Stanley Grand-Girard, electrical engineer, Sharon Steel Corp., Sharon, Pa.; W. D. Rees, superintendent bar and blooming mill, Sharon Steel Corp., Lowellville, Ohio; W. W. Bentz, superintendent maintenance, United States Steel Corp., McDonald, Ohio; C. J. Duby, chief engineer, Republic Steel Corp., Warren, Ohio; Edward E. Offerdahl, superintendent electrical maintenance department, Copperweld Steel Co., Warren, Ohio; E. O. Reese, assistant superintendent hot strip mill, Youngstown Sheet and Tube Co., Youngstown, Ohio; A. S. Glossbrenner, vice president-charge operations, Youngstown Sheet and Tube Co., Youngstown, Ohio.

AIR POLLUTION SYMPOSIUM

. . . . the steel industry has made tremendous strides in cleaning up air pollution where practical methods have been developed . . . .

"AIR POLLUTION CONTROL IN STEEL INDUSTRY"

By G. A. HOWELL

Assistant to Chief Engineer

Steel Manufacturing

U. S. Steel Corp.

Pittsburgh, Pa.

▲THE wide range of processes and equipment used in the production of steel products presents many and varied problems. When one considers the size and variety of the operations in the steel industry, the magnitude and complexity of minimizing air pollution can be readily visualized.

When thinking of this industry most persons are inclined to visualize only the large steel producing centers. However, the mills and furnaces are now spread over 30 states, with more than 400 plants making or finishing steel in 250 communities.

In many of these communities there are presently in force, or in preparation, ordinances to control emissions from all types of fuel burning devices. With respect to fuel burning equipment, such as stoves, boilers and similar devices, we know that by either changing fuels or by installing mechanical firing or fly-ash arresting equipment, stack emissions can be controlled within a reasonable limit. This is evidenced by the progress already made in steel as well as other industries.

Fortunately, in the Pittsburgh district, or to be specific in Allegheny county, the Smoke Control Ordinance provides that a program of research be undertaken to determine practical methods of controlling emissions caused by blast furnaces, open hearth furnaces, and bessemer converters. Reports indicating the status of the research are submitted annually to the Bureau of Smoke Control. The ordinance also permitted steel companies to participate in a joint program of research on these subjects if they desired. Accordingly, a joint committee to guide this research was established between several large steel producers. Members representing operating personnel, engineering, research and technology constitute the committee personnel.

Let us consider some specific steelmaking operations and see what progress is being made by this joint committee in their attempts to control atmospheric emissions.

OPEN HEARTHS

The first approach was a study of dust loading throughout the various periods of melting and refining in the open hearth. The method used for sampling the dust loadings is a modified Brady method. This comprises filtering a metered volume of gas through a paper thimble. From the change in weight of the thimble for a given amount of gas, the dust loadings can be calculated.

Because it was found that the dust loadings vary appreciably during the course of the heat, a sampling program was developed that would properly represent the conditions. The heat was broken down into six periods: the melt down, hot metal addition, ore boil, lime boil, working heat and empty furnace.

A large number of samples were obtained for each period and for a number of different heats in order to find the average and maximum dust loadings. The work done to date has been carried out for the most part on oil-fired furnaces. The dust loadings vary widely, ranging from almost zero to as high as two grains per standard cubic foot at peak loads. The average dust loading is about 0.43 grains per standard cubic foot in an oil-fired open hearth. Peak loads are obtained during the period of hot metal addition, ore boil, the lime boil, and when working with oxygen.

A study of the particle size of the material collected shows that approximately 50 per cent by weight of the dust from an oil-fired open hearth is smaller than five microns, with only a few per cent above 20 microns.

Many particles smaller than one micron are present. The small size of these particles can be appreciated when we consider that the smallest individual particles visible to the naked eye are about ten microns in size; the minute particles in cigarette smoke are about 0.1 to 0.2 microns in size.

It may be mentioned that fume is defined as the product of vaporization and subsequent condensation of a material. This produces a particle size range between 0.1 and 1.0 micron. The term "dust" refers to mechanical dispersoids formed by dispersing larger masses into finer materials, as by grinding. By this process, it is difficult to obtain particles smaller than five microns in size. This very large difference in size between fume and dust is emphasized by the fact that a 10-micron dust particle has 8,000 times the volume and weight of a ½-micron fume particle of the same composition.

Chemical analysis shows an iron oxide content of about 90 per cent.

During the melting of an open hearth heat, the color of the flue gases coming from the stack varies from white to reddish brown. One point of particular interest here is the lack of correlation between the color and the dust loadings, which precludes the use of a modified Ringelmann chart for the open hearth. However, the use of a photo-electric cell will be tried in an endeavor to develop a more convenient and less expensive method of sampling the stack effluent.

As soon as the study of open hearth dust loadings at the various open hearth shops with their different methods of operation was completed, an investigation of equipment to control the emissions was undertaken.

The fact that there is a large percentage of fume present in the stack gases from an oil-fired open hearth indicates that either an electrostatic precipitator or a high-energy requirement wet washer will be needed to reduce the solid content of the stack emission by more than 50 to 60 per cent.

ELECTRIC PRECIPITATORS

Electrical precipitators, under the right conditions, will remove particles of any size from the gas. An upper limit of 15 microns is generally adopted because particles above this size are usually removed less expensively by other methods. The advantage of the electric precipitator is that there is, in general, no theoretical limit to the efficiency obtainable. Of course, high efficiency requires large installations and, therefore, high costs. A problem in electrostatic precipitation is that in many cases the particles in the gas stream must be conditioned in order to bring the equipment to a practical operating size. The main effect of conditioning is to impart a high surface conductivity to the particles in order to permit the discharge of ions to the collecting electrode. Water vapor or other conducting substances, which can be absorbed on the particles, are added in those cases where the surface conductivity of the particles is inadequate.

While in most cases lower gas temperatures are desirable, an optimum temperature of about 700 F has been found for the case of cement dust, and a few precipitators are operating at much higher temperatures than this.

DUST WASHERS

Dust washers have been widely used by industry and are quite effective in applications in which the particle size of the dust to be removed is not too small. They can be used to remove particles down to 0.1 micron. However, the finer the particulate matter to be removed from the gas by the washer, the greater will be the power requirement per thousand feet of gas cleaned. In practice, this energy is applied in three ways. In some dust washers the energy is supplied by high pressure water sprays. Water pressure as high as 4,000 psi has been used. In other cases the energy is supplied by the gas, as in the case of the Venturi scrubber. In this unit the gas passes at very high velocity through a sheet of water. The sheet of water is broken up into extremely fine droplets. In the third type of washer, the so-called disintegrator, energy is applied in mixing the gas and water in the washer itself.

The reason that so much energy must be used in a washer removing the small particles is that these particles have so little mass that it is difficult to bring them into contact with the water. They tend to act like a gas and move away from the water droplets.

There are two additional disadvantages associated with the use of dust washers: first, the high maintenance costs resulting from corrosion; and second, the difficulty in removing the particles from the water in order to comply with stream pollution laws. The latter problem is especially acute when removing particles of very small size.

In addition, in some localities water is in short supply and its price may make its use prohibitive. Where wet washers are used to clean stack gases just before discharge to the atmosphere, a plume of steam is usually seen emerging from the stack. This may be very undesirable, since the appearance of the stack gases may be as bad after cleaning as before. This factor of appearance of the stack gases rather than the degree of cleaning of the stack gases has been emphasized of late by many of the large public utilities. They feel that the public will be convinced that they have ceased to pollute the atmosphere only when the stack gases are nearly invisible.

Several types of equipment, such as sonic coagulators, pebble filters, dry and wet type collectors, and electric precipitators, have been studied in connection with open hearth gas cleaning, but the results have not proved too encouraging. However, the cost of installing and operating such equipment appears to be very high and may be prohibitive, particularly if the stack must be rendered visually clear, which requires a reduction of 95 to 98 per cent in the stack emission. Further experimentation on a pilot plant basis on an open hearth furnace with an electric precipitator, singly, and in various combinations with dry and wet dust collectors is scheduled for the near future to accumulate data on efficiencies and costs. The development of less expensive equipment to clean fumes from gas is a challenge to the gas cleaning industry.

It may be well to mention at this time other results

which have been obtained on dust loadings from open hearths. Data of this kind obtained from open hearths in Los Angeles County, have been published which show loadings averaging 0.8 grain per standard cubic foot. However, because of the nature of the scrap used and the fact that since there is no blast furnace operated in conjunction with the plants, all the metal charge enters the furnaces cold, and the nature of the dust is quite different from that found elsewhere.

Published data on the open hearth stack loadings at the Donora plant of the American Steel and Wire division show a dust loading of 0.02 to 0.07 grains per standard cubic foot, using natural gas as a fuel. Some preliminary data, which have been taken in the Pittsburgh district, have shown dust loadings of 0.10 to 0.40 grains per standard cubic foot when natural and coke oven gas are used as fuels.

It has been determined that about 90 per cent by weight of the solids collected from the stack gases of a gas fired open hearth are smaller than five microns. This size distribution means a difficult cleaning problem. Because of the small particle size, the stack gases appear dirty, even though the fume is present in small amounts. This then is another case wherein it must be decided whether the standard for cleanliness is to be measured in concentration of solids or is to be a visual inspection of the color of the stack gases.

The recent practice of using oxygen applied directly to the bath during the working period of the heat may add a complication. There is a reference in the literature to the use of a Venturi scrubber for removing the dust under these conditions. It is reported that the mean diameter of the particles is in the range of 0.25 to 0.33 microns with many particles down in the 0.50 to 0.10 micron range. Efficiencies of 97 to 99.7 per cent, on a weight basis, were reported, but the power requirements and maintenance costs are reported to be extraordinarily high.

BESSEMER CONVERTER

There does not appear to be a ready answer to this problem. A major difficulty lies in the design of a suitable arrangement to confine the gases for treatment. Once the gases have been confined, the dust loadings and the characteristics of the solids will be measured.

AISI RESEARCH PROGRAM

Additional help on these problems can be expected in the future from the work sponsored by American Iron and Steel Institute at the Industrial Hygiene Foundation at the Mellon Institute. They are working for the most part on sampling methods and training personnel for air pollution abatement work in the various steel plants.

BLAST FURNACES

The cleaning of blast furnace gas has long been a well established art. It is being practiced on a huge scale. Today, more than 7,000,000 standard cfm are being cleaned.

Since the dust particles in blast furnace gas vary from one-quarter inch to a tenth of a micron, the plants are arranged to remove the dust in three stages. Cyclones remove the large particles, low-energy requirement wet-washers (primary cleaners) remove the next smaller sizes, and electrical precipitators or high-energy requirement wet-washers (secondary cleaners) remove the smallest size particles. Although secondary cleaners are being operated with final dust loadings of less than 0.001 grains per standard cubic foot of blast furnace gas, such cleaning can be justified only in those cases where the gas has special use, such as for underfiring coke ovens or for firing stoves. Well-designed and operated primary cleaners meet the requirements of most anti-smoke ordinances.

Many types and combinations of types of cleaners have been used. The primary wet cleaners include stationary spray towers, revolving spray towers, Feld washers, baffle towers, and spray fans. Primary dry cleaners have included modifications of cyclones, centrifugal machines, filters and electric precipitators.

For secondary cleaning, wet and dry electric precipitators, Theissen disintegrators, high-speed disintegrators and filters have been used.

In the case of the wet cleaners, the dirty water must be conducted to a thickener or settling basin. The treatment of the recovered dust consists of sintering or briquetting to prepare it for return to the blast furnace. One objection to thickeners is the large ground space required.

Blast furnace slips is another problem confronting the steel industry. Every blast furnace operator is extremely interested in preventing slips because they result in loss of production and materials and cause variation in quality of the iron. This problem has received study by many blast furnace operators and hope has been expressed that present investigations on further instrumentation of the blast furnace to bleed cleaned gas during all but the heaviest slips may lead to a satisfactory solution of the problem. Several modifications of this system have been proposed. It will take considerable time of service testing to evaluate and prove the merits of the various systems.

As the raw materials going into the blast furnace are improved, the tendency to slip shou'd decrease. Therefore, the large investment being made in sintering and coal preparation plants will be helpful in solving this problem.

Still another problem occurs in the case of furnaces producing ferromanganese. The amount and types of dust from a ferromanganese furnace are different than those from a basic blast furnace. Only about 20 per cent of the dust is larger than 20 microns. From the chemical analysis, it has been found that this fraction of the dust is made up mainly of particles of coke and ore. These apparently have been broken off the burden and blown out of the furnace. They are removed from the gas stream by a conventional dust catcher and briquetted for return to the furnace.

The rest of the dust is a true fume having particles sized between one-tenth and one micron. The average particle size is 0.1 to 0.5 micron. The manganese content varies from 15 to 25 per cent. A rather unusual feature is the alkali content of from 8 to 15 per cent.

The alkalies which were present in the manganese ores are concentrated by the process of vaporization and condensation and form a part of the fume. United States Steel personnel have undertaken the development of a process for removing the fume from the ferromanganese blast furnace gas. To determine the practicality of the process and to obtain design information necessary for the large plants required to clean the gas, a pilot plant handling 3,000 standard cubic feet of gas per minute was installed. The operations were encouraging and, as a result of this work, a plant has been designed to clean 135,000 standard cubic feet of ferromanganese blast furnace gas per minute. A complete discussion of the many phases involved would be lengthy and would require the preparation of another paper, which would be concerned mainly with the question of disposal of the removed material.

SELF-POLICING

The steel industry in Allegheny County, Pa., developed and initiated a voluntary "Self-policing" program directed at accomplishing the broad objectives of the Allegheny County Smoke Control ordinance by means not specified in the ordinance. Each plant has a smoke abatement coordinator to whom are reported infractions together with courses and corrective measures applied. A monthly summary of these infractions, if any, on various facilities presently covered by the ordinance is compiled by each plant and transmitted to a central point within the individual company. All infractions are tabulated on a final report form which also includes their causes, corrective action, and what present or long range program is contemplated to minimize infractions, which form is then signed by a company representative and submitted to the county director of smoke control.

This "self-policing" program involves considerable time and work, but it serves a definite and useful purpose. First, all operators of combustion facilities are made more cognizant of their responsibilities to perform their duties correctly and efficiently. Secondly, it brings to the attention of the plant officials what operators are dilatory in their approach to smoke abatement, and disciplinary action is applied if previous instructions and warnings have been disregarded. Finally, an over-all picture is presented to company officials as to what is being accomplished. They in turn can discuss the different aspects of the smoke control problem with the coordinators and plant officials.

SUMMARY

This paper has discussed the experiences that the steel industry has had in Allegheny County in attempting to solve several air pollution abatement problems of particular concern to the industry. There can be no such thing as push button control in the steel industry because each type of facility represents an individual requirement for study, with particular units of a type presenting even further problems to solve and overcome.

"AIR POLLUTION AND REMEDIES"

By J. J. SEAVER

President

J. J. Seaver Engineers

Chicago, Ill.

▲AIR pollution is the release of dust, fume, mist and odors into the atmosphere from any source. This includes those produced by nature and industrial plants.

Most people think pollution of the air is entirely man made and comes from industrial plants only, whereas, nature contributes a large share to this cause. Pollution produced by nature has always been with us, in one form or another. This situation is usually taken for granted and it is assumed that nothing of much consequence can be done to improve it.

Much of nature's air pollution is caused by the wind, which blows dust and other light solids about promiscuously over large areas. One consoling feature of nature's pollution, however, is due to the fact that the wind is usually preceded or followed by a rain. The rain water increases the specific gravity of the dust particles, thus throwing them down on the buildings and ground in the rain covered area, and by so doing, cleanses the air to a great extent.

The writer has seen such severe dust storms in Mexico that the visibility was reduced so that airplanes could not operate.

Experiments have been carried on to produce rain artificially by dropping chemicals in rain clouds. To date the production of rain by this method cannot be considered a success. And not until such time as rain can be produced more practically, can we have much control of air pollution produced by nature.

Man made air pollution is somewhat different, as both the cause and remedy can be controlled. This form of air pollution is generally thought of as the release of solids only, into the atmosphere. However, odors are just as much of an offender and require treatment also. One will be quite conscious of this, if they live near the stockyards, chemical, or other plants dispersing odors into the atmosphere. Exhaust fumes, from gasoline engines using plain gasoline, have already been successfully neutralized. And it is said that a new catalyst developed has a good possibility of clearing up the fumes from gasoline containing lead.

Experiments have been carried on at a hot slag granulating pit to counteract the sulphur odors generated in the production of expanded slag. The hot slag is water cooled quickly, this generates steam and unpleasant sulphur odors that pass off into the atmosphere. To correct this nuisance, two nozzles have been installed at each slag dumping position which shoot a chemical over the pits while the cooling water is on. It is said that the sulphur odor and chemical mist react with each other and now pass off unnoticed.

City streets and most main highways, once a great source of dust, have been paved. And those in congested areas remaining unpaved, now are usually sprayed with water, chemicals, oil or tar to eliminate the dust and air pollution.

Many industrial plants, having dust, fume and odor release problems, have built very high chimneys or draft stacks. The high chimneys only partially solve their problem by dispersing the solids, fume and odor over a much wider area. Another solution to this same problem is to pass the discharged products through water mist on their way to the stack exit. This will increase the specific gravity of the solids and throw a high percentage down at the bottom of the stack. But this solution usually creates two additional problems; one is the removal of sludge, and the other is the loss of stack draft.

burners in place of the single one in each end of the furnace.

This will give complete combustion of the fuel within the bath area, with short, sharp directed flames. Then the products of combustion should be made to pass out around refractory deflectors and turn 180 degree angles with slow velocity over long settling chambers to the exit. This will cause all of the heavy and 95 per cent of the light solids in the products of combustion to be deposited in the slag pockets, and not pass into the regenerator chambers and out the stack, thus polluting the atmosphere.

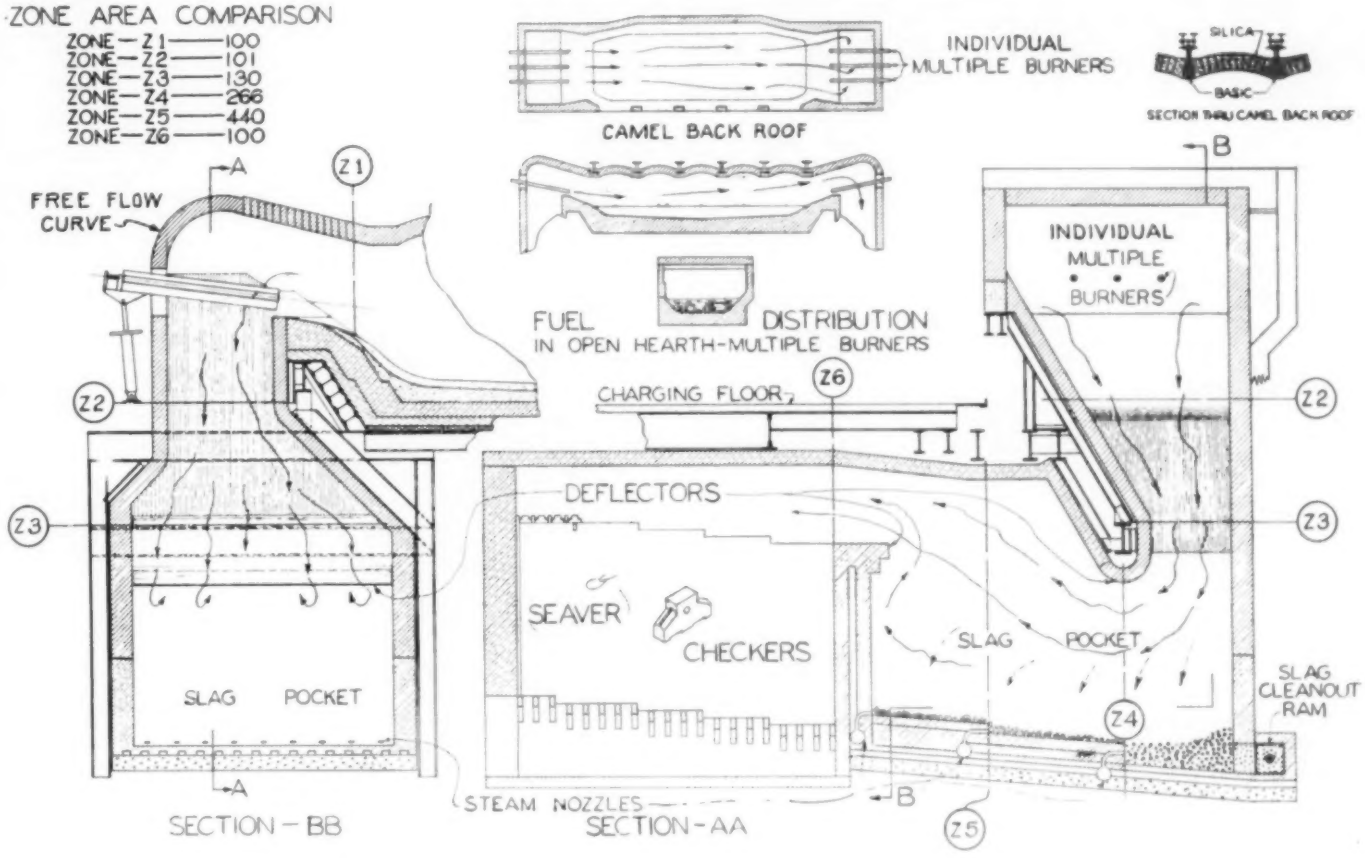

Figure 1 — Deflector helps remove solids in open hearth furnaces.

Many dust problems could be much improved, if discharge spouts were brought down closer to the piles on which the discharge is being made. Also a better condition is achieved by the use of closed zipper locking conveyor equipment now available.

Incomplete combustion of fuel and improper handling of the products of combustion contribute considerably to air pollution. Boiler plants are often operated with poor distribution and insufficient air for good combustion. This gives poor boiler efficiency with much black smoke going to the atmosphere.

Blast furnaces and open hearth furnaces are offenders of air pollution too. Some blast furnace operators say that a furnace slip occasionally cannot be avoided. Open hearth operators maintain that they cannot clear up the stacks, until better means are provided for this purpose. The open hearth operator has reason to complain in most cases. For instance, the combustion system could be improved by installing multiple individual

All of these simple corrective means which will not only improve air pollution, but operating conditions as well, are shown on Figure 1.

In general air pollution is now recognized as a serious problem and better solutions are continually being sought.

"THE ROLE OF ELECTRICAL PRECIPITATION IN THE STEEL INDUSTRY"

By H. L. RICHARDSON

District Manager

Research Corp.

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▲THIS paper discusses the application of Cottrell electrical precipitation equipment in the steel industry.

The use of this equipment in this industry over the past two decades has proceeded at an accelerated rate until today it is applied on a wide variety of gas cleaning problems. It is the purpose of this paper to discuss in general some of these problems, describe the equipment used, and point out some of the results obtained. Before however we go into these matters in detail it might be wise to review the overall reasons as to why dust collecting equipment, including electrical precipitators are used to clean industrial gases.

Generally speaking there are three main reasons as follows:

1. For the removal of suspended materials adversely affecting the utilization of the gases for industrial purposes.
2. For the recovery of valuable suspended materials from the gases before they are discharged to atmosphere.
3. For the reduction of atmospheric pollution.

In the steel industry, the principal applications fall

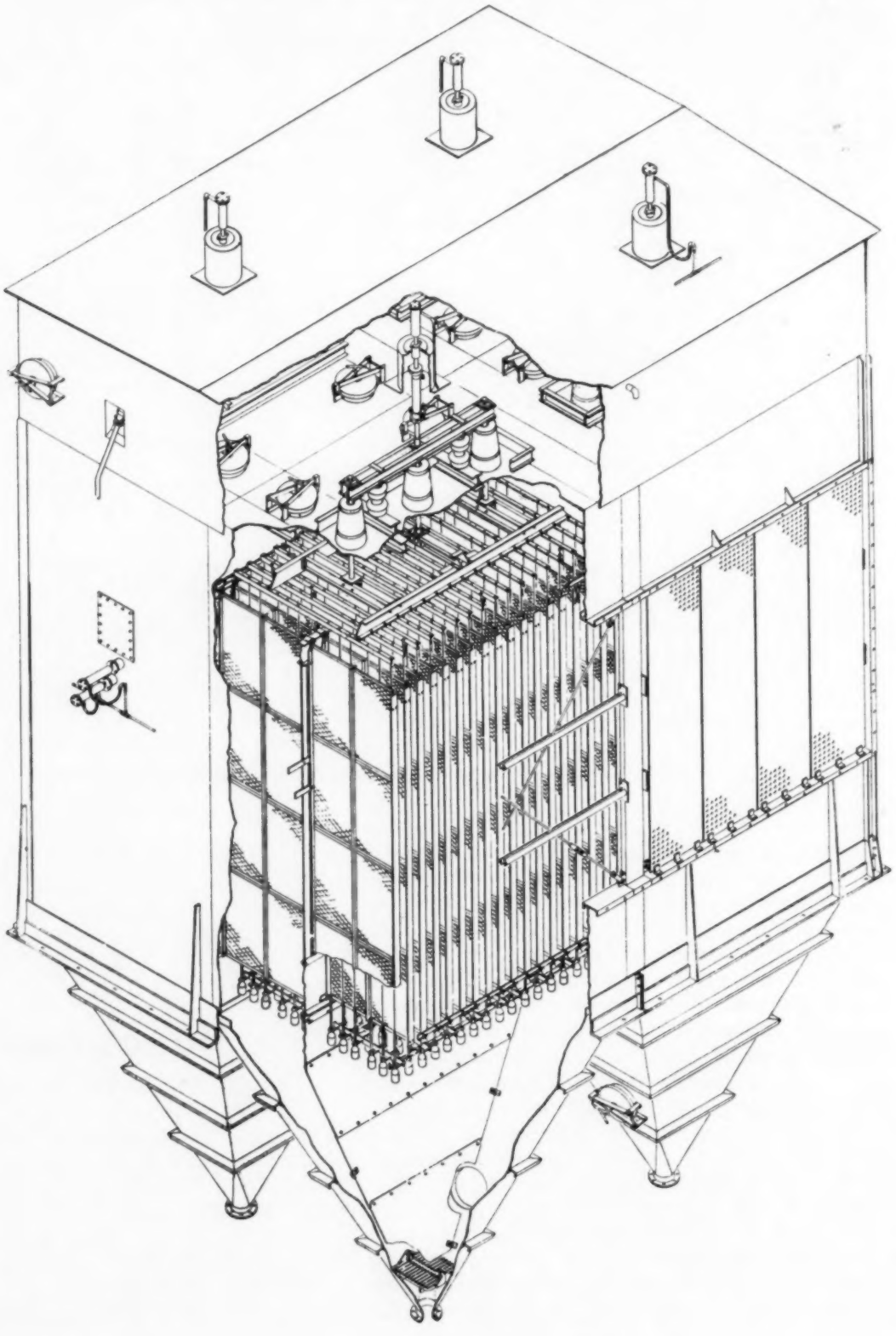


Figure 1 — Schematic sketch shows details of plate type electric precipitator.

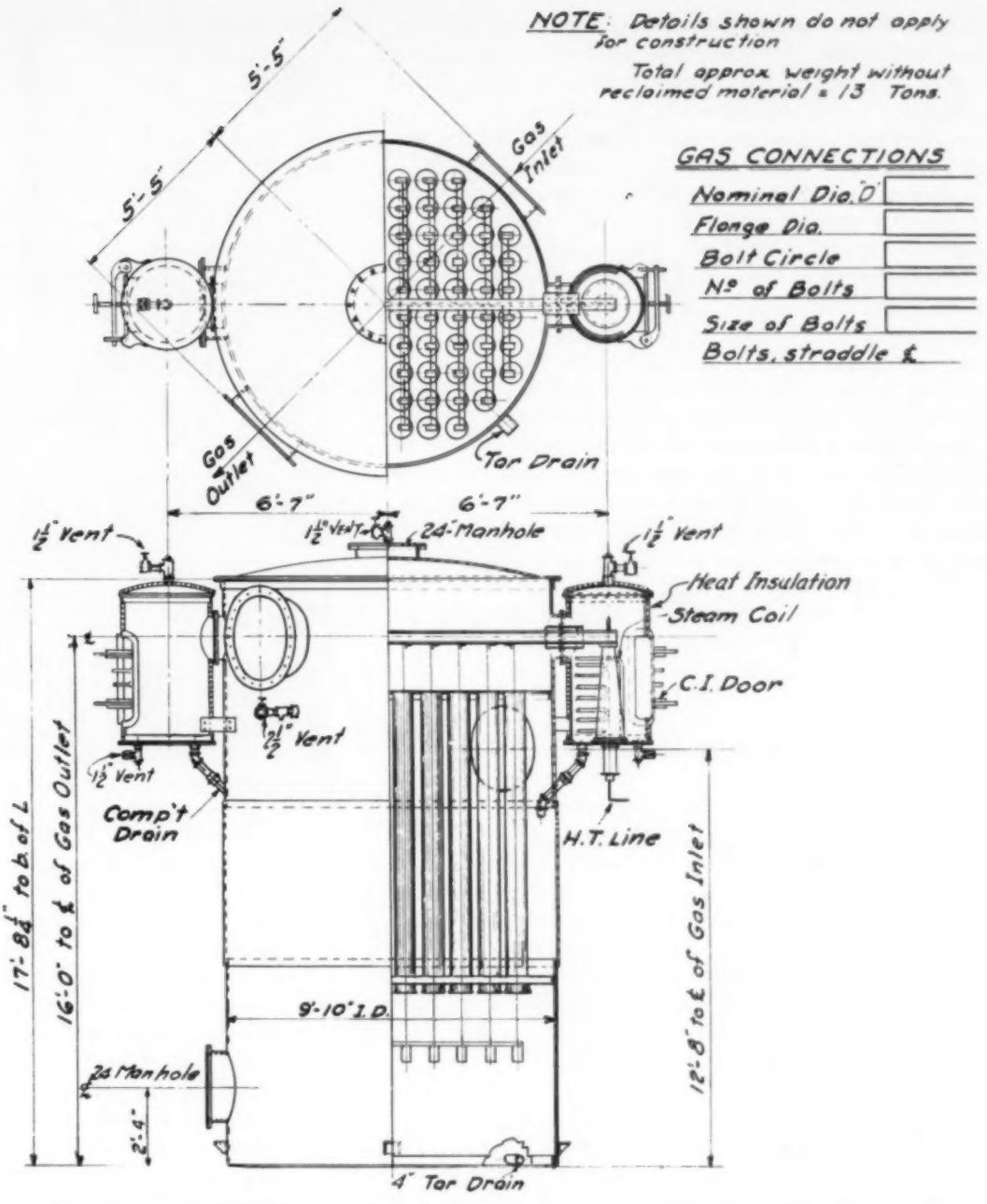


Figure 2—Pipe type precipitator shown here is used for collection of tar.

under the first or third category, although in some cases there might be a combination of reasons.

Before, however, we discuss some of the applications in the various classifications we believe that it might be wise for the benefit of those who may not be completely conversant with electrical precipitation to briefly outline the principles of operation and equipment used.

PRINCIPAL OF OPERATION AND EQUIPMENT

In the operation of a Cottrell precipitator of the type manufactured by us, a high unidirectional difference of potential is maintained and current flow set up between two spaced sets of electrodes through which the gas is passed. One set of these electrodes, which are known as the discharge electrodes, are usually filamentary, while the other set, known as the collecting electrodes, have large surfaces. The high voltage impressed across the electrodes ionizes the gases and produces a corona effect at the discharge electrodes. The ions thus formed attach themselves to suspended particles in the field and the resultant charged particles are attracted to the electrode of opposite electrical sign. The particles thus collected on the electrode give up their charge and are then removed to hoppers underneath the electrodes by rapping or vibration in the conventional manner. Thus it can be seen that the removal of suspended particles from gases in a precipitator really proceeds in four steps: (1) charging by means of gas ions produced by the high voltage discharge, (2) migration of the charged particles to the electrodes, (3) discharge of the particles at the electrode, (4) removal of particles from the electrodes to a point of storage.

The basic parts of an electrical precipitation installation consist of: (a) the precipitator in which the gases are treated and the material removed, and (b) the electrical equipment for producing the proper electrical energy for the precipitator.

In practice there are a number of different types of

precipitators, but in general they can be divided into two basic types—namely, plate and pipe type. These can be further broken down dependent upon the actual design of collecting electrode, and materials of construction, into such categories as steel perforated plate, rod curtain, etc. The plate type treater (Figure 1) is made up primarily of a shell in which are located a series of parallel plates (collecting electrodes) thereby forming ducts through which the gas passes. In the center of these ducts are suspended a series of discharge electrodes from an insulated framework. The pipe type precipitator (Figure 2) consists of a number of pipes (collecting electrodes) nestled in a header plate within a shell or between headers with a discharge electrode suspended axially from an insulated framework in the center of each pipe. In both types, the high voltage current is conducted from the electrical equipment to the discharge electrode. The collecting electrodes are grounded through the shell, thus completing the circuit through ground to the electrical equipment.

With the foregoing principles and outline of the equipment in mind we would now like to discuss some of the major applications of this equipment in the steel industry.

APPLICATIONS IN STEEL INDUSTRY

1. *Detarring of by-product coke oven gas*—This is probably one of the oldest applications and involves the removal of tar and oil fogs or mists from the coke oven gas. The purpose of these installations is to remove the tar and oil from these gases to prevent contamination of subsequent materials or products, eliminate operating difficulties such as plugging, and obtain a relatively clean gas for distribution and utilization.

   The precipitator used by us for this purpose is usually of the pipe type involving 6 or 8-in. diam collecting electrodes. They are usually located after the exhauster and before the ammonia saturators, and are designed in most cases to effect a 95 to 99 per cent removal of the suspended tar and oil present in the gas at inlet to the precipitator. This application is fairly well established as standard practice in the steel industry.
2. *Cleaning of oven fuel gas*—In addition to the precipitator installation made in the by-product plant, many installations incorporate a precipitator to further remove the last traces of tars and oil from the so-called oven fuel gas or the gas used for under firing the ovens. With the small orifices or burner ports now used on a modern oven installation, this is desirable in order to eliminate plugging of the burners. The gas for this purpose has usually been cleaned in the by-product precipitators, but in order to eliminate the last traces of suspended matter, is further cleaned in an installation located near the ovens. This precipitator is likewise of the pipe type.

   In both this and the by-product precipitator, experience has shown that the materials precipitated are free flowing, the collected tar and oil flowing down the inside surfaces of the pipes to the bottom and hence through a seal to the tar sump.

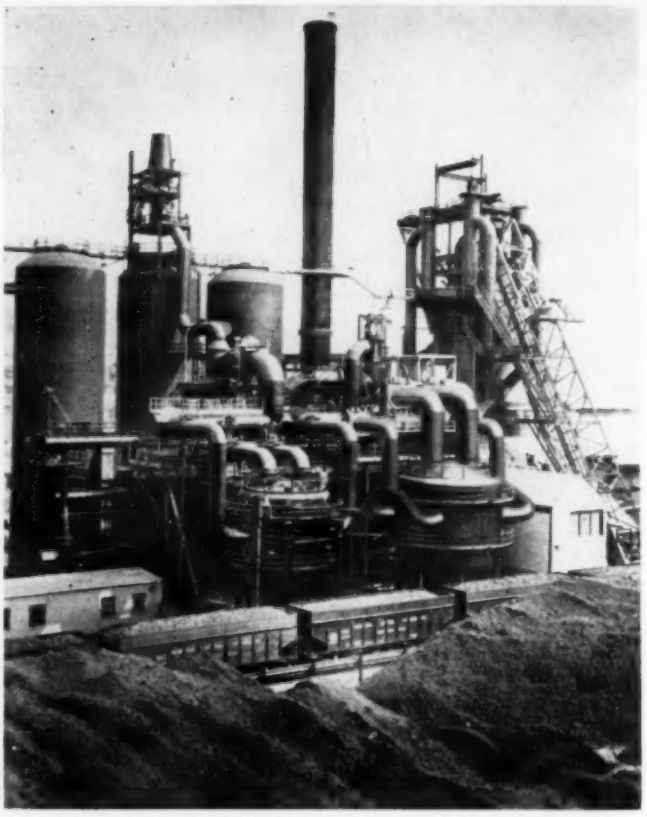


Figure 3 — Secondary cleaning on blast furnaces is normally done with precipitator.

3. *Secondary cleaning of iron blast furnace gas (Figure 3)*—The fact rarely appreciated by other than the combustion engineer is that the largest tonnage of material produced in the blast furnace is the gas. In normal practice in this country, for every ton of iron tapped, the furnace generates about five tons of gas and for every ton of iron produced per day the heating value of the gas produced is approximately 0.45 tons of coal per day. It is quite evident that full utilization of this gas is required for an economic production of iron and such utilization requires that the gas be adequately cleaned.

   The gas cleaning plant in most iron blast furnace installations consists of the preliminary stage (dry dust catchers), the primary stage (water scrubbers) and the secondary stage (water flushed electrical precipitators).

   The dust and fume content of the gases by the time it gets through the washers or scrubbers has usually been reduced to the range of 0.1 to 0.3 grains per cubic foot of gas corrected to standard conditions. The function of the electrical precipitator is to further clean this gas to a final dust content ranging in most cases of from 0.005 to 0.01 grains per cubic foot. The final cleanliness is dependent to a large extent upon its use.

   To accomplish this so-called secondary cleaning of the gas, we again utilize the pipe type of precipitator with a continuous water overflow system. With this design, the upper ends of the pipe type collecting electrodes are fitted into a header

plate which is divided into ponds by means of vertical metal strips welded to the header and which enclose uniform groups of pipe. An adjustable weir ring is fitted to the top of each pipe and the top of all weirs adjusted to the same level. Controlled amounts of water are then supplied to each pond which overflows the weirs and form a uniform liquid surface over the inside surface of each pipe electrode. The dust is precipitated upon the water film and hence carried to the bottom of the precipitator to drain and seal. Thus with this type of precipitator, the collecting electrode is actually the film of water flowing over the inside surface of the pipe electrodes. These units are made in standard sizes with or without double partition walls and with either side or top inlet connections. They can be designed for almost any efficiency required. Water consumption ranges in general from 150 to 300 gallons per 100,000 cubic feet of gas and power consumption from 0.4 to 1 kwh per 100,000 cubic feet of gas. Pressure drop is usually less than ½ in. of water.

The foregoing applications are the principal types of installations made in the steel industry under the first classification; namely, the removal of suspended matter adversely affecting the utilization of the gas for industrial purposes. There is in addition another application which rightfully could be included in this group, but which, in view of the limited number of furnaces, and the fact that the first commercial installation has not as yet gone into operation, will not be discussed at this time. This involves the cleaning of ferro-manganese gas. Extensive pilot plant investigations have indicated that this problem can be effectively handled in precipitators and we confidently expect that the results on the commercial installation now under construction will be satisfactory.

Inasmuch as there are practically no problems of a general nature in the steel industry coming under the second classification; namely, the recovery of valuable suspended matter, we will proceed to a discussion of some of the problems coming under the third category. This involves the cleaning of waste gases to prevent the discharge of suspended matter to atmosphere. Some of the problems of this nature confronting the steel plant engineers are those in connection with the gases from open hearth furnaces, iron cupolas, iron ore sintering machines, scarfing machines, electric furnaces, and power plant stacks where solid fuels are used. Space does not permit discussion of all of these problems, but a few are presented which are of primary interest.

Open hearth gas cleaning (Figure 4)—One of the more recent applications of electrical precipitators is the cleaning of open hearth gases resulting from the manufacture of steel in the open hearth process. As a result of extensive studies made with a pilot plant installation a few years ago, we determined that this problem could be solved by electrical precipitation in a satisfactory manner. This problem as you know involves the cleaning of combustion gases coming from furnaces, usually oil fired, and carrying in suspension a heterogeneous chemical mixture of metallic oxides. As a large part of the suspended matter is the result of the fuming operation the material is very fine. The solids concentration on the basis of our experience varies quite widely dependent upon the type of operation in the furnace. For example, on one installation during the melting period, the concentration varied from 0.18 to 0.44 grains per cubic foot during tapping, and in the boiler lancing period, it increased to 1.2 to 1.55, and during the working period was in the order of 0.4 grains.

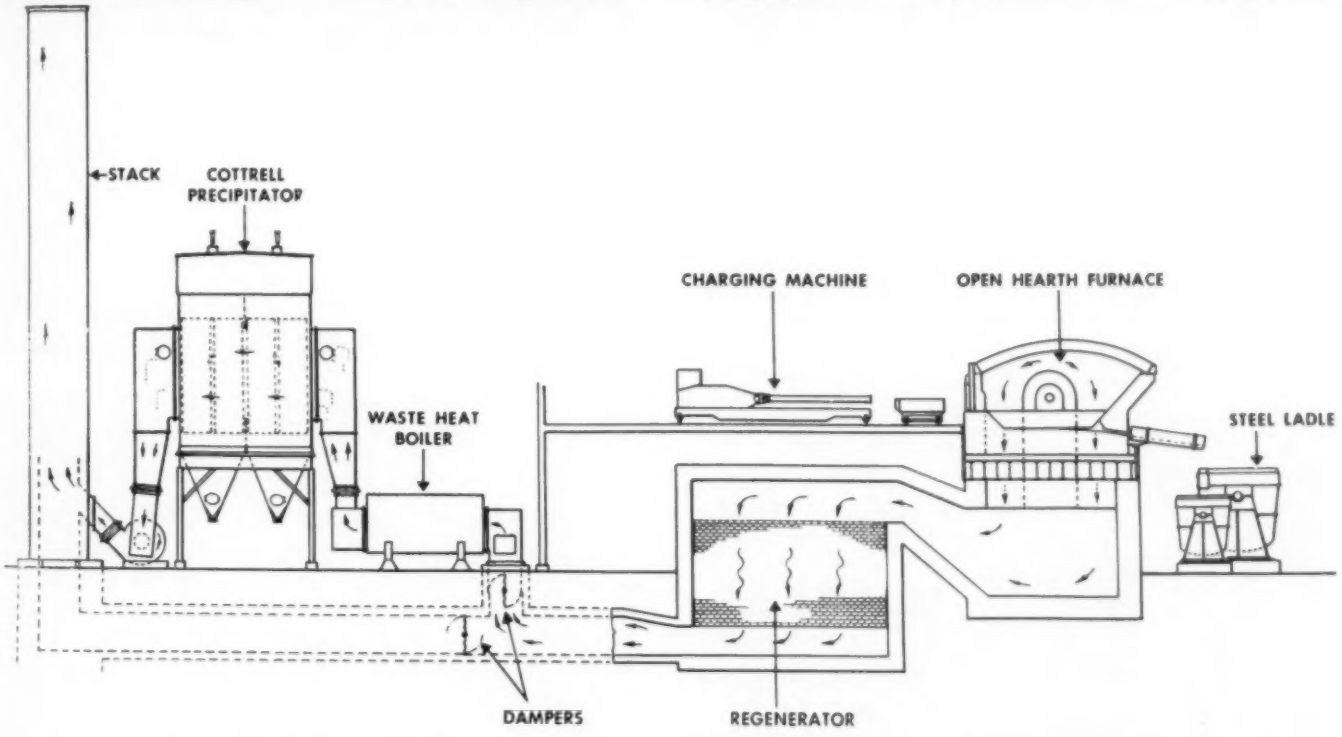


Figure 4 — Gas flow drawing shows use of precipitator for cleaning open hearth furnace gas.

As a result of the pilot plant work a commercial installation on four furnaces was made. The first of these went into operation in 1950 and all have now been oper-

ating for sometime. The results have been in our judgment quite satisfactory.

The precipitator for this type of operation is of the steel plate type similar to that which we use for power plant work. As the gases leaving the furnaces usually are in the range of 1200 F and temperatures of 400 to 450 F at precipitator are desired, it is necessary to cool these gases. To accomplish this cooling, waste heat boilers and/or spraying with water can be utilized.

Iron cupolas (Figure 5)—The use of electrical precipitators for cleaning gases from iron foundry cupolas was demonstrated successfully with a pilot plant installation in 1950. Since then a number of commercial installations have been placed in use. Some of these are installed on the so called hot blast type of cupola while at least one is used on the ordinary cold blast type of cupola.

The gases leaving either the cupola or the heat exchanger (dependent upon the type of cupola installation) pass to a cooling tower where they are cooled and conditioned by spraying with water to a temperature of approximately 350 to 450 F. From the cooling tower the gases pass to the precipitator hence to fan and stack.

The precipitator used on this application is of the steel plate type and can be designed for either horizontal or vertical flow. The material is precipitated upon the collecting electrode plates and removed to the hoppers by means of the magnetic impulse rapping system.

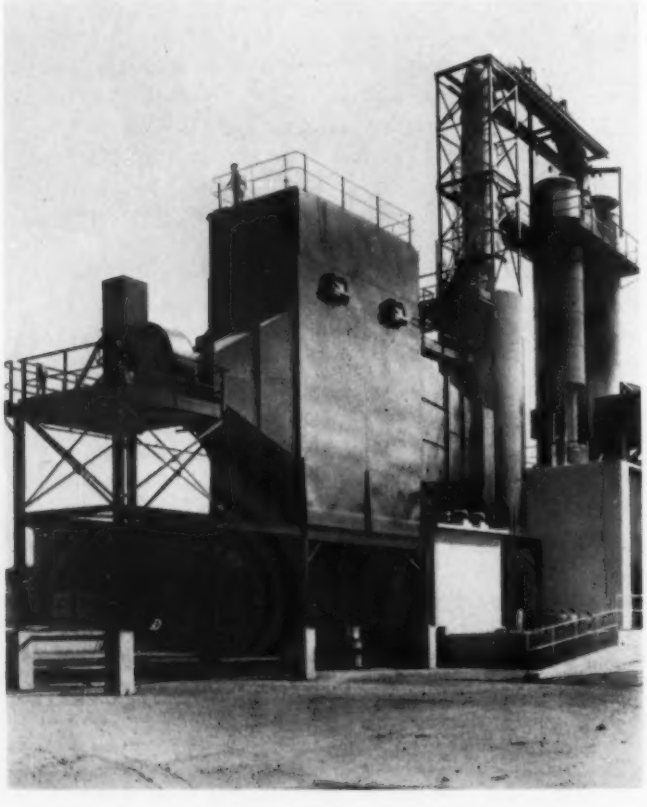
Iron ore sintering machines—Another recent application for the plate type precipitator is in the cleaning of gases coming from iron ore sintering machines. The first commercial Cottrell installation of this type was placed in operation last year with collection efficiencies exceeding 95 per cent. In this installation, the gases leaving the windboxes of the sintering machine pass to a flue, hence to a mechanical collector, to the induced draft fans, to the precipitator, to stack. The gases enter the precipitator at temperatures ranging from about 250 to 300 F, with water vapor content of about 8 per cent. The dust collected is dry and quite fine.

The precipitators used on this application are also of the horizontal steel plate type and incorporate magnetic impulse type of rappers on the collecting electrodes. This installation is energized from vacuum tube type rectifying sets located in cabinets. The total gas volume for which this installation (three precipitators) is rated 375,000 cfm at 300 F.

Scarfing machines and electric furnaces—While there has been considerable interest in the possibility of utilizing electrical precipitators for cleaning the gases from these operations, and while we are at the present time proceeding with the work in connection with a commercial installation on each of these problems, nevertheless in view of the fact that we have not placed any of these commercial installations in operation, we believe that it would be preferable to hold any discussion on these applications in abeyance at this time.

Power plants—As the removal of fly ash from the flue gases coming from pulverized coal fired boilers is an application which has been established for many years, we will not go into detail in this connection. Suffice to say that this problem can be effectively handled in electrical precipitators which are usually of the horizontal flow steel plate type.

Figure 5 — Precipitator shown is installed on an iron cupola of the cold blast type.



CONCLUSION

In the above we have tried to show some of the problems which confront the gas cleaning engineer in the various fields in the steel industry and describe some of the applications of electrical precipitation equipment to these problems.

We believe that the progress made in these fields has been very good and we feel that the technology of the application of Cottrell electrical precipitation equipment has kept up with the technology of the field itself. As in other technical fields, there is no such thing as a static condition. Progress has been, and will be made. We believe that as knowledge of these fields increase, the demand for better gas cleaning equipment will also increase, and we believe that the betterment of the Cottrell process will more than keep up with these demands.

"DUST AND FUME PROBLEMS IN THE STEEL INDUSTRY"

By RICHARD F. O'MARA

General Sales Manager

Western Precipitation Corp.

Los Angeles, Calif.

▲THE general subject of dust and fume problems in the iron and steel industry is very comprehensive. However, an attempt will be made to give a broad out-

line of these problems and to discuss a few of the major ones in some detail.

The very fact that the Association of Iron and Steel Engineers is having a smoke abatement symposium is indicative of the changing attitude of management throughout the iron and steel industry. A few years ago one of our salesmen called at a steel plant and was told that they had no dust problems, but that he could leave some literature and they would call if they needed any advice or equipment.

Benjamin F. Fairless, in his widely distributed talk "The Boy Next Door," has publicly expounded the current and future top management policy relating to the cleaning of waste effluents, either to the atmosphere or to the sewer. The new Fairless Works is an outstanding example of this new policy in the industry. The industry is to be congratulated on its outlook relative to suppression of dust and fume.

		Settling Chambers	Large Dia. Cyclones	Multicyclones	Wet Scrubbers	Cloth Filters	Electrical Precipitation: Heavy Duty: Film Type	Electrical Precipitation: Heavy Duty: Dry Type	Electrical Precipitation: Light Duty	Mist Filters
1.	RAW MATERIALS HANDLING									
	a) ORE			●		●				
	b) COAL			●		●				
2.	COAL CRUSHING & PREPARATION		●	●	●	●				
3.	COKE OVENS									
	a) COKE OVEN GAS						●		●	
	b) COKE SCREENING PLANT		●	●	●					
4.	BLAST FURNACE PLANT									
	a) BASIC IRON FURNACE	●		●	●		●	●		
	b) FERROMANGANESE FURNACE	●		●	●			●		
	c) BLOWER AIR					●			●	●
	d) CONTROL ROOM AIR					●			●	
	e) AIR TO ELECTRICAL EQUIP.					●			●	●
	f) STEAM POWER PLANT			●				●		
5.	SINTERING PLANT		●	●				●		
6.	BESSEMER CONVERTER	●		●	●			●	●	
7.	OPEN HEARTH									
	a) RAW MATERIALS			●		●				
	b) WASTE GASES				●			●		
8.	ELECTRIC FURNACE				●			●		
9.	DEPT. POWER HOUSES				●	●			●	
10.	SCARFING MACH. (BLOOM MILL)				●		●			
11.	FURNACES (COAL FIRED)			●				●		
12.	PICKLING UNITS				●				●	

Figure 1 — Present and possible future applications of gas and air cleaning equipment in the steel plant are indicated by the points on this chart.

There are three main reasons for the use of dust and fume recovery apparatus; namely:

1. To clean valuable waste gases from blast furnace and coke ovens so that these gases can be profitably used.
2. Clean air for:
   a. Protection of personnel.
   b. Protection of equipment.
3. Nuisance abatement.

In a typical over-all steel plant operation there are approximately twelve major areas in which some form of dust or fume control equipment has an application. These are shown in Figure 1.

ORE HANDLING

The receipt of ore at the dock and its subsequent transfer from boats to stockpile or transfer cars is usually carried on in such magnitude there is little that can be done to control dust. The subsequent handling of the ore to the blast furnace high dock and finally to the furnace offers some additional dust emission and collection problems. In plants where the ore is passed through a screening operation prior to its being fed to the blast furnace or sintering plant, the screening plant process and material handling equipment can be protected with hoods, ventilating fans and recovery equipment such as cloth filters. Naturally, the dew point is a critical item here.

LIMESTONE

Limestone handling offers little or no dust problem, since it is mostly handled in large sizes with very little fines. Problems will exist at the limestone preparation plant, where again cloth filters offer a reasonable solution.

COAL HANDLING

Coal crushing, blending stations and belt transfer points are all places to which consideration can be given for suitable hooding, dust removal and recovery equipment. In such plants the original engineering should include space at least for future dust control.

SINTERING PLANT

The traveling pallet type sintering equipment is coming into more and more common use, and these units are being equipped with mechanical collectors, either separately or in series with electrical precipitation equipment. Each plant must be considered separately, since the dust and fume problem will depend upon the sintering plant operation, the relative amounts of screened ore fines, limestone fines, returned blast furnace dust, dewatered and filtered fines from primary washers, coke breeze or coal.

The gas volume to be handled varies from 120 to 160 cfm per ton of sinter per day. The dust loading to the multiclone unit will vary over a wide range from approximately 3 grains to ½ grain per cubic foot or less. The coarser fraction is removed by means of large diameter cyclones or more efficient small diameter tubes in multiple units. Dust content to the electrical precipitation unit is in the range of 0.2 to 0.6 grains per cubic foot. Temperature will be in the range of 250 to 400 F.

The recovery efficiency of mechanical collectors is in the range of 80 to 85 per cent, and with the combination of mechanical collectors and precipitators, the over-all efficiency will be in the range of 98 to 99 per cent.

Figure 2 shows an outline drawing of a typical sintering plant operation with multiclone and precipitator for dust collection. Figure 3 illustrates a cross section of the Cottrell electrical precipitator used in series with the mechanical collectors. Many of these are used in steam power plants. The draft loss across the mechanical collector and precipitator is 2½ to 3 inches water column.

Table I, giving data on sintering operations in two different plants, shows the wide variation that can be expected, particularly in dust loading.

A dusting problem exists at the exit end of the machine where separation of coarse and fines is made. Multiclone units have proven satisfactory here to remove dust. The large pieces of sinter for the blast furnace or open hearth offer little or no dust problem.

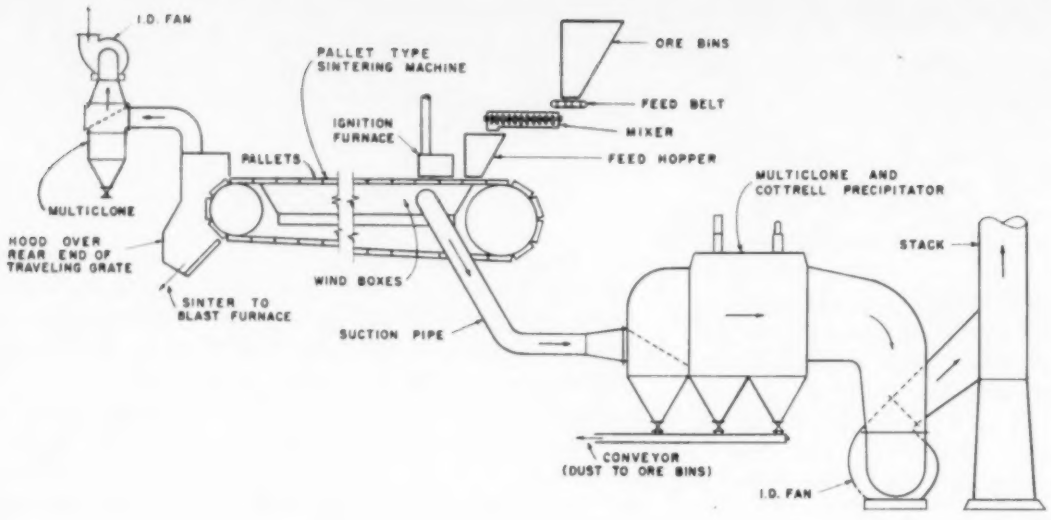


Figure 2 — Diagrammatic view shows a dust handling system applied to a pallet type iron ore sintering machine.

However, the fines being returned to the feed bins are dry and hot, and may or may not be troublesome, depending on method of conveying and dumping into bins.

COKE SCREENING PLANT

The charging and discharging of the coke ovens and the subsequent cartage to the quenching station and quenching are all of such a magnitude that any dust or vapor problem is not currently considered of a serious nature. The same is true of the handling of coke on the coke wharf. The coke screening plant, where roughly 70 per cent of the coke is sized for the blast furnace, and 30 per cent consisting of the fine fractions sent to the power house or disposed of separately, offers a number of sources of dust which can be satisfactorily taken care of through suitable hoods, ventilation and recovery equipment. However, this is a difficult job once a plant has gone into operation and it would be desirable to include or at least make provisions for dust recovery equipment at the time the plant is being built.

Figure 3 — General assembly shows combination multiclone and electric precipitators for a public utility on the east coast.

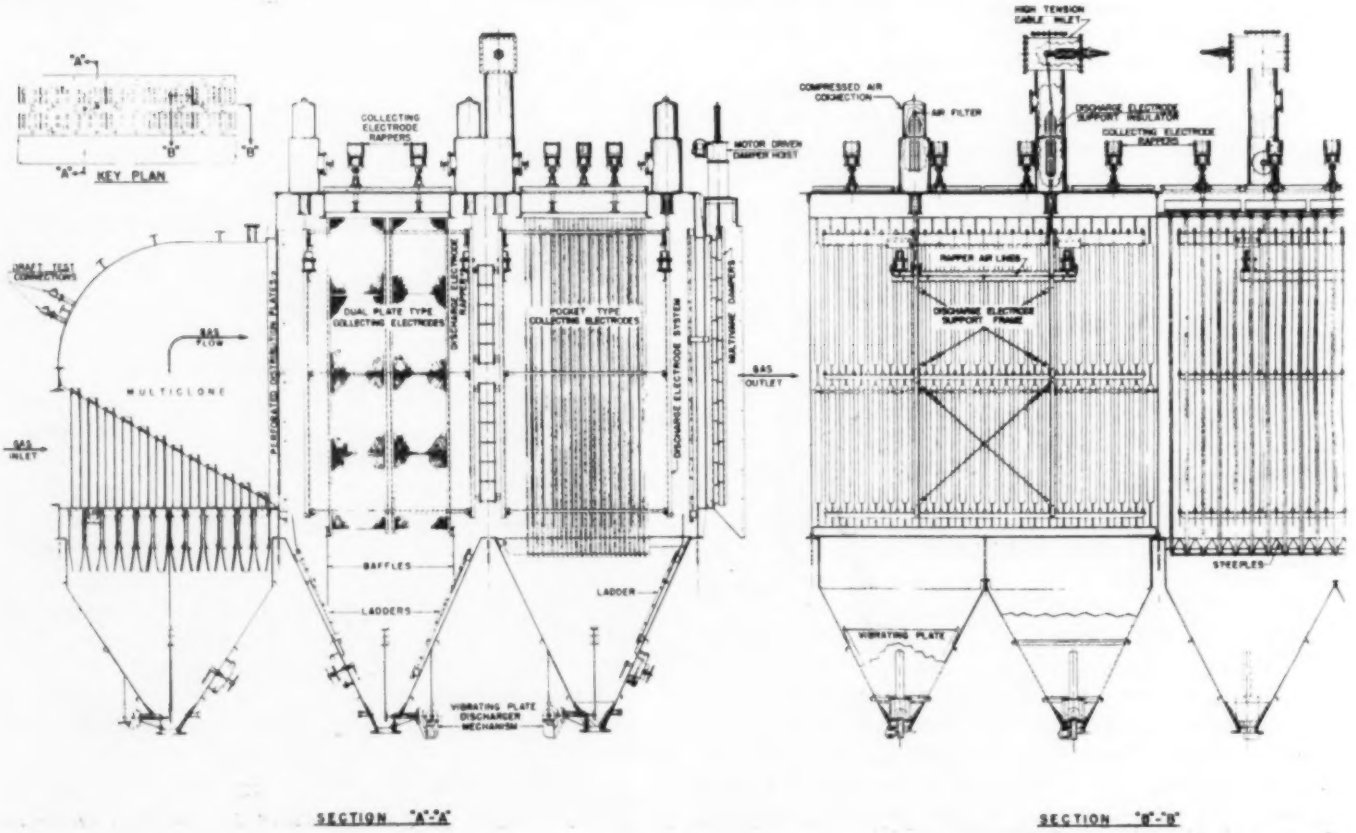


TABLE I

Sintering Plants

	Plant "A"	Plant "B"
Size of machine	84 in. x 125 ft	72 in. x 102 ft
Tons per day per machine	1,000	1,250
Raw material —		
Ore, per cent	80	91
Blast furnace dust, coal or coke	20	9
Gas volume from sinter machine, cfm	160,000	148,500
Temperature of entering gases, F	250	375
Particle size, per cent minus 10 microns	22	17
Dust content — Grains per cu ft (at above temperature)		
Mechanical collector, inlet	3.08	0.176
Mechanical collector, outlet	0.40	0.036
Mechanical collector, per cent efficiency	87	80
Precipitator efficiency, per cent	75	.....
Over-all efficiency, per cent	97	.....

COKE OVEN GAS CLEANING

Coke oven gas cleaning by means of electrical precipitators, either in single or two-stage operation, is considered standard practice in the industry and is extensively covered in the literature.

BLAST FURNACE

Dust removal from iron blast furnace gas is perhaps the most familiar ground where members of the dust cleaning companies meet the steel industry. With furnaces being blown at ever increased rates, dust production has increased enormously. Primary gas washers are handling more gas, and as a result electrical precipitator loads have increased. Where precipitator inlet concentrations were of the order of 0.1 to 0.2 grains per cubic foot, these are now reaching 0.3 grains and over. Nevertheless, higher efficiencies are being sought to maintain cleanliness at boilers, stoves, soaking pits and coke ovens.

New 1400-ton furnaces with air blast in excess of 100,000 cfm are now common. These are being provided with improved scrubbers to reduce the dust to 0.20 grains or less and then followed with precipitators to provide concentrations for coke ovens of less than 0.003 gr per cu ft and less than 0.007 for steam power boilers and gas mixing stations.

It has been only recently that any major design changes have occurred in blast furnace gas precipitators. The advent of the center inlet design, after considerable experimentation, has proven to have advan-

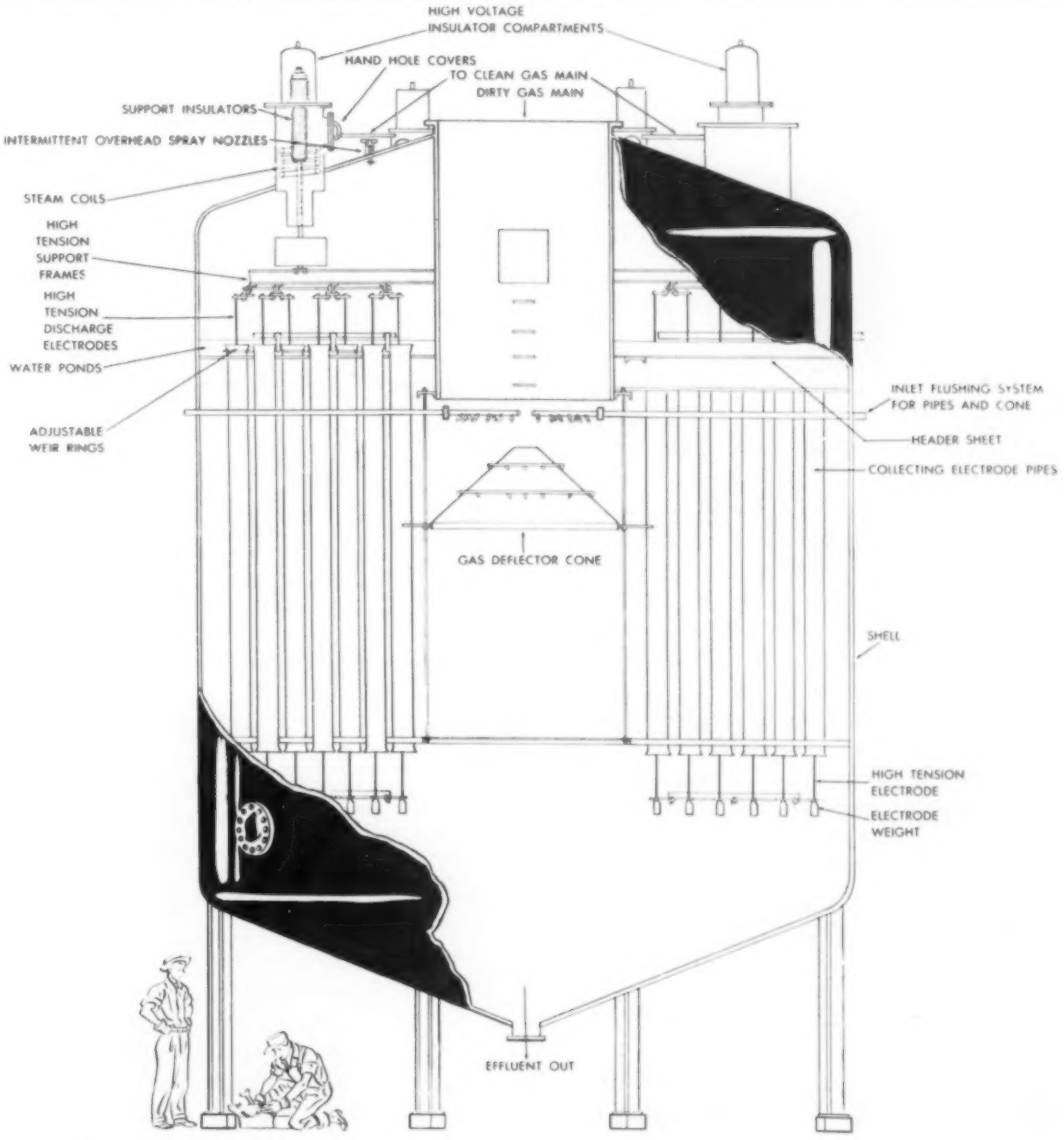


Figure 4 — Schematic shows center inlet of blast furnace precipitator. This type design is meeting with increased favor for blast furnaces.

tages over former designs. Features of this are shown in Figure 4. The single center inlet for dirty gas has provided better distribution to the collecting tubes. Modifications to electrode supports, electrode spacer grating, pond arrangement and flushing system have reduced or eliminated former problems. More than 25 of these units have been supplied to the steel industry, both in this country and abroad

Test data from a recent Australian installation show dust concentrations as great as 0.265 gr per cu ft inlet have been cleaned to 0.0031 grains outlet. Consistent cleaning from 0.2 to 0.3 grains to below 0.004 grains is being obtained. You will all realize how much this helps the power house or coke oven operator.

Extensive work has been done on ferromanganese blast furnaces by the steel industry and this problem has been solved by a special adaptation of electrical precipitation.

Other uses of cleaning equipment in the blast furnace area including blower air, where screen type filters followed by light duty precipitators, are used. Erosion of the air side rotor with consequent loss of efficiency might some day show interesting data in particularly dirty areas. Likewise, air for control rooms, cooling electrical equipment and general power house use might indicate economies.

Much in the public eye is the desire of the steel industry to reduce open hearth stack emissions. This vari-colored material, which we all like to see as it indicates prosperity, has its disadvantages. In Los Angeles County, for instance, regulations permit only a 40-lb-per-hr discharge from a process handling in excess of 60,000 lb-per-hr. Open hearth furnaces of 225-ton charges are in such a category.

Thus far, few open hearths have been equipped with electrical precipitators. In California, four small furnaces, melting scrap, have been successfully equipped. However, this is not what the steel industry considers as standard for open hearth practice. One 225-ton furnace has been recently equipped in a Western steel plant and a number in a new Eastern plant. These furnaces are standard hot metal and scrap charge for ultimate production of tube and flat rolled material.

The open hearth, with its many stages of scrap charging, hot metal additions, ore, lime and alloy requirements is a real problem to the art of electrical precipitation. The word "art" is used, since from every one of the operating phases a different dust is produced in varying concentrations with different gas flows and temperatures, and this constantly changing group of variables prevents precise and calculated design. Resistivity of the dust, moisture and temperature of the gas greatly influence the precipitator operation. The problem is to find one set of design conditions for a specific open hearth furnace that will provide the best over-all average results in the precipitator. Each installation usually requires some field adjustment and so far no operating data is available. See Table II.

TABLE II

Open Hearth Furnaces

	Plant "A"		Plant "B"	
Furnace capacity, tons	.....		225	
Type of operation	Melting scrap		Hot metal	
Cfm (at operating temperature)	33,000		74,500	
Temperature, F	550		650	
Precipitator size	1 Unit, 2 Sections		1 Unit, 2 Sections	
Dust content — grains per standard cu ft				
Inlet, maximum	2.0		2.43	
Inlet, average	0.72		0.50	
Particle size distribution — microns, per cent	−3+1	7.3	+5	6
	−1+0.5	28.4	−5+1	34
	−0.5+0.15	49.5	−1	60
	−0.15	14.8	.....	
Chemical analysis, collected dust, per cent	Pb	10.7	Pb	3.8
	Fe	6.1	Fe_2O_3	23.1
	Zn	28.3	ZnO	10.0
	S	11.1	S	8.4
	Cr	0.6	Na_2O	5.7
	Mn	0.3	K_2O	28.5

OPEN HEARTH RAW MATERIALS

The handling of raw materials around an open hearth plant, such as lime, ore and ferro alloys produces some dusting problems, but, again, practical and economical considerations govern.

DEPARTMENT POWER HOUSES

Steel mill power houses contain a multiplicity of high horsepower motors, generator sets and controls requiring cooling air in large quantities. Economics and space considerations bring up many interesting problems of recirculation, refrigeration, make-up air, dew point and cloth type cleaning equipment. Power houses throughout the nation are noted for their cleanliness and unless air pollution is retarded, better and more cleaning equipment is indicated.

BESSEMER CONVERTERS

Bessemer converters offer the dust control engineers probably the most challenging problem in the steel industry. The equipment is large and the operations are carried out on a sizable magnitude. In addition, the operation is cyclic and the temperature, gas volume, dust and fume vary over a wide range.

Average size converters handle charges of 20 to 35 tons with two to three cycles per hour. The gas volume at the converter throat is controlled by the blower, but the temperature will range from ambient to 3000-3500 F.

Solids in the gas stream may be molten, plastic, solid metallic particles or oxides condensed from the gases in the form of fume particles. These latter particles are in a sub-micron range.

Suitable hooding provides an engineering dilemma. If the hooding is close to the converter, problems in high temperature and spittings adherence can be a source of trouble. Since the converter flame may be 40 feet or more in length, hooding at some distance from the converter throat has possibilities, but this reduces the probability of collecting all of the dust and fume and increases the total gas volume that must be han-

dled in the collection equipment. Aside from the high temperature and spittings problems, the movement of the furnace and flame are additional complications.

Test work in the field by sampling with a simple pipe inserted in the gas stream and cooled by radiation indicates dust loadings in the order of 0.8 gr per cu ft. Mechanical collector efficiency, using 9-in. tubes, is in the range of 70 per cent. However, data indicates that electrical precipitation can be used satisfactorily and any desired efficiency obtained.

ELECTRIC FURNACE

Here, the question of confining gases to as small a volume as possible is again important. In most cases a great deal of ingenuity is required in the design of satisfactory hoods and accessory equipment. In existing plants with little available room the problem is aggravated. For new plants, consideration should be given to providing space for possible future gas cleaning equipment.

Figure 5 shows a diagrammatic arrangement of an existing plant with two 75-ton furnaces and one 50-ton furnace in successful operation. The collecting duct encloses the three electrodes as closely as possible and is a part of the swinging furnace roof. In the closed position, this duct matches up with the entrance to the flame hood, a brick and steel structure mounted beside each furnace, having one horizontal reversal of gas flow. Its design and size was dictated by the space available. Water is sprayed into this hood up to a rate of 25 gpm and is all evaporated. This serves partially to humidify the gases and quench the flames. Fan suction provides ample draft with the exception of the more violent periods of bath reactions when some gases escape collection. The collected gases pass through uninsulated steel flues to a spray tower where the inlet temperature range is 300 to 500 F, and loading up to approximately 1 gr per cu ft.

The gases are cooled by direct contact cooling with water sprays at the first tower, marked "A," and the quantity of sprayed water is controlled by the temperature in the third tower. Water from the towers is taken from and recirculated.

Approximately 25 per cent of the dust is zinc oxide fume, which is very difficult to collect. Experience shows that each electric furnace problem will need to be investigated before suitable collection equipment can be designed.

For small furnaces, such as those used for making steel castings, it is sometimes possible to dilute the gases to 200 F, or less and use a bag filter.

Where machine turnings, oily scrap and bundles, containing a number of non-ferrous metals are charged, it may be necessary to scrub the gases first and then pass them through a steel or wood pipe type electrical precipitator.

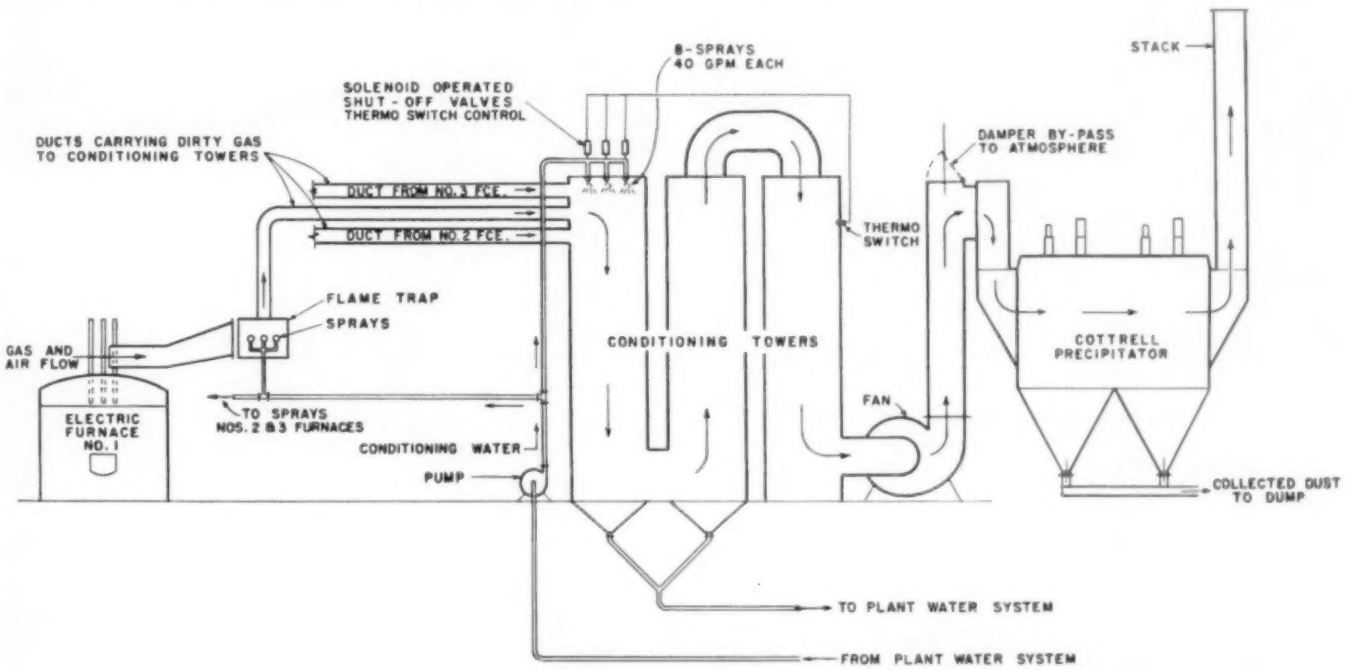


Figure 5 — Flow diagram shown is used for cleaning exhaust gases from a multiple arc furnace installation.

BLOOMING MILL

There is very little dust formation in the blooming mill operation; however, the introduction of scarfing machines introduces a new problem.

The hot, moist fume and dust-bearing gases are being handled in an electrical precipitator at one plant. This is not an easy problem as, again space limitations in existing plants make layouts difficult.

HOT STRIP MILLS

Oxide formation at the exit side of six-stand continuous hot strip mills may or may not cause sufficient nuisance to make consideration of gas cleaning equipment important. Large volumes containing small concentrations mean large equipment and again hooding and collecting ducts become disproportionately large.

PICKLING PLANT

Modern types of continuous type pickling operations are usually provided with a ventilating system to remove fume and these are ordinarily exhausted to the atmosphere through rubberlined flues and fans. Since these gases rarely get beyond the confines of the plant property, such nuisance, as is involved, is generally an inter-plant problem.

POWDERED FUEL HEATING FURNACES

The powdered fuel heating furnaces for large forgings and the like can be provided with mechanical collectors to recover the majority of the fly ash. These are installed and currently being used in some plants.

SUMMARY

The making of steel is not a clean operation by any means, and all operations are carried out on a large scale. This makes any dust recovery problem both costly and more difficult to handle.

The steel industry has the widest range of dust problems that exist in any industry and the dust collector manufacturers and the steel plant engineers, both, have a lot to learn in the development of satisfactory answers.

There are more dust collectors of more varied types and kinds in steel plants than in any other industry.

A good start has been made, and with the present cooperation by the engineers in the steel industry, the dust collector manufacturers and, particularly, the smoke inspectors, much will be accomplished in the immediate years ahead.

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"THE ELECTRIC AIR CLEANER"

By GEORGE F. LANDGRAF

Vice President in Charge of Engineering

and

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Industrial Sales Manager

Trion, Inc.

Pittsburgh, Pa.

▲THE pollution of the atmosphere with man-made contaminants is not a new problem. Early records show that in 1293 the use of coal was prohibited in England because it was considered harmful to health. However the burning of coal continued to increase, and in 1306 a royal proclamation was issued banning its use. One man, reported to have been caught burning coal, was condemned to death and executed.

Fortunately drastic smoke control ordinances of this nature are no longer possible. On the other hand, industry throughout the country is faced with the problem of complying with ever more stringent legislation aimed at curbing stack emissions. We all agree that the discharge from smoke stacks and chimneys should and must be cleaned up. However, we must also realize that these are not the only sources of atmospheric pollution.

Our modern civilization produces dirt in hundreds of ways that are extremely difficult if not impossible to control at the source. For example, consider the amount of dirt generated by the wearing of the millions of automobile tires in use. According to one authority, a single tire during it life, by friction with the surface upon which it travels, produces 750 billions of rubber particles. Multiply this number by the yearly consumption of rubber tires in the United States and the astronomical figure of over 60 quintillion (6^{19}) dust particles is obtained which, in accordance with this assumption, is directly attributable to this one source alone.

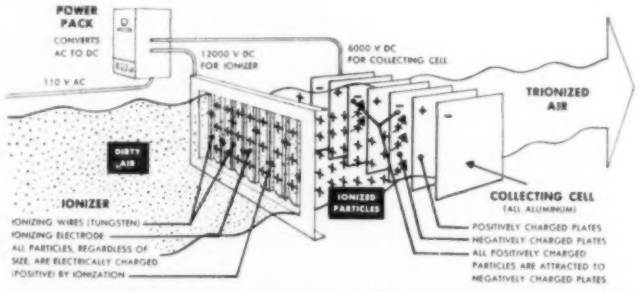


Figure 1 — As illustrated above, all particles in the air — even those of sub-microscopic size — are electrically charged (positive) as they pass through the high voltage ionizing screen. These particles are then attracted and adhere to collecting plates, which form the negative elements of an electrostatic field set up between a series of parallel plates, electrically charged alternately positive and negative.

When we further consider the atmospheric contamination caused by ore handling, slag dumps, open pit mining, forest fires, dust storms—to mention but a few —we see that clean air cannot be realized by stack control alone. It follows that to a large extent the air we breathe must be cleaned at the point where it enters the air handling system of our homes, factories and offices. The most practical means of removing fine dirt particles from the air is by the use of the electronic air cleaner.

Electrostatic precipitation is not new, although until rather recently, it has had very little popular application. As early as 600 B.C., history records that Thales, one of the seven wise men of Greece, observed the attraction of an amber rod for dust particles after it has been stroked with silk. As far as is known, the removal of suspended particles from gases, by means of electrostatic precipitation, was first discovered in 1824 by Hohlfeld of Leipzig, Germany. He found that an elec-

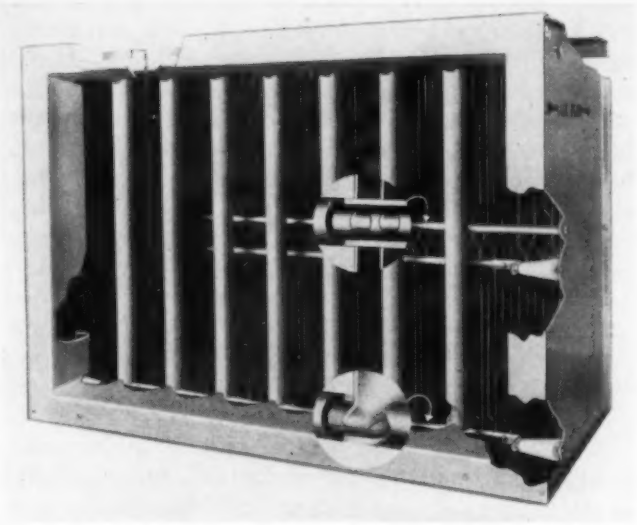


Figure 2 — The ionizing-collecting cells are constructed of aluminum for corrosion resistance and ease of handling. The venturi nozzle of the ionizer prevents by-pass of uncleaned air and permits the installation of insulators out of the air stream — reducing by-pass of uncleaned air.

trified wire when hung in a bottle filled with smoke caused the particles of smoke to collect on the sides of the jar.

In 1906, Dr. Frederick G. Cottrell, acting in a consulting capacity for the Selby Smelting and Lead Company of San Francisco, developed a practical electrostatic precipitator for the removal of sulphuric acid fumes from the effluent gases of a gold and silver smelting operation. Since that time, numerous applications of similar apparatus have been applied to effluent gases from industrial processes that would have created a nuisance in the neighborhood if they had not been cleaned before they were exhausted. The majority of the early applications were for the elimination of air pollution so serious that surrounding plant and animal life suffered.

The original electrostatic precipitator as evolved by Dr. Cottrell was not applicable to the cleaning of ventilating air, principally because an intolerable amount of ozone and oxides of nitrogen were generated in the process.

The Cottrell precipitator in its simplest form was nothing more than a tube 6 to 10 inches in diameter, suspended in a vertical position and so arranged that the gas to be treated would pass through it from bottom to top. Suspended in the center of the tube axially and insulated electrically from it, was a wire usually square in cross section and having relatively sharp corners. On this wire was impressed a high potential negative charge (45 to 75 kv) causing the wire to emanate negative ions toward the grounded internal wall of the tube. The high potential was produced by simply stepping up the voltage of an alternating current and subsequently rectifying it to direct current. The original rectifiers were all synchronously driven rotary switches. In fact, this type of rectifier is still used widely in the Cottrell type precipitator, although the electron vacuum tube has been successfully applied in a number of instances.

When the dust laden gases passed upward through the tube, the dust particles collided with and retained on their surface, a number of the negative ions emitted from the wire, thus becoming negatively charged. Since the wall of the tube was positive with relation to the wire, the negatively charged particles were attracted toward the tube wall and if the tube was long enough and the speed of the particle parallel to the tube was not too fast, this attraction would cause the particle to lodge on the wall of the tube before it could progress to the end. The tubular type precipitator finds its greatest application in the removal of liquid mist or fogs, where tiny droplets having been attracted to the tube's inner

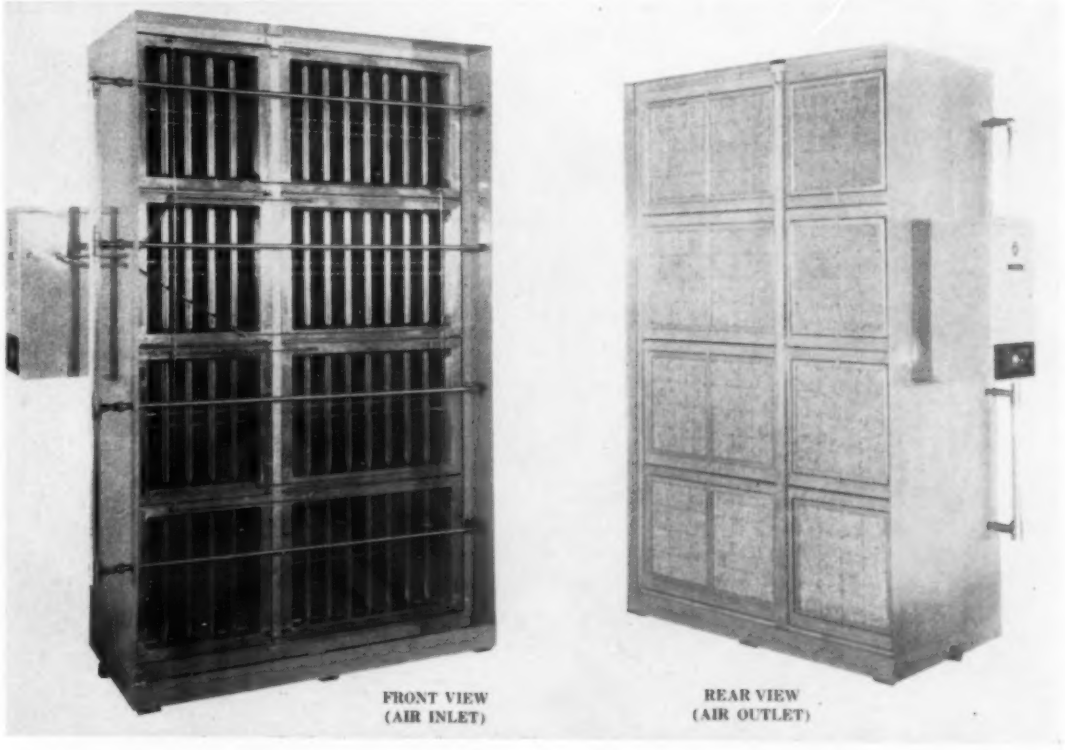


Figure 3 — Typical field assembled equipment. Unit shown is capable of cleaning 13,300 cfm of air at 90 per cent efficiency. This type of equipment is used extensively in buildings, steel mills, schools, hospitals, pharmaceutical, food and textile plants.

surface finally build up a sufficiently thick film so that they run down the tube and drain out at the bottom.

For dry dusts or fumes, the Cottrell type precipitator generally takes the form of a series of plates suspended from 6 to 9 in. apart, between which there is suspended a series of ionizing wires equally spaced from the adjacent plates and from 3 to 5 in. apart. As in the case of the tube, these wires are suspended on an electrically insulated structure and are maintained at a high negative potential. In this type precipitator, the gas to be treated flows horizontally between the plates and the dirt particles are charged and are attracted to the grounded plates in much the same way as the tubular type precipitator. With dry dust it is necessary to rap or vibrate the plates occasionally to shake the collected dust down into a hopper provided below the gas stream.

In 1938, a modified development of the basic phenomenon of precipitation was patented by Dr. Gaylord W. Penney, an electro-physicist from Pittsburgh, Pa. This later development provides a separate ionizing section and collecting section. In its original embodiment, the ionizer consisted of tubular electrodes installed vertically across the horizontal air stream. These electrodes were spaced aproximately 2½ in. apart. In between and equally spaced from each of the adjacent tubular electrodes, fine tungsten wires were suspended on insulated supports. These wires were maintained at a positive potential of 12 kv. Immediately behind the ionizer was located a series of vertical plates between which the air from the ionizer was forced to flow. These plates were supported in such a manner that the alternate plates were grounded and the interleaving plates were insulated from ground. The plates were maintained at approximately ⅜-in. spacing and the insulated plates were charged with a positive potential of 6 kv. As the dust laden air passes through the ionizer, the tiny dust particles pick up a positive charge of ions which are being emanated continuously from the fine wires, and then as the particles pass in between the vertical plates, they are influenced by the electrostatic field created by the potential difference of the alternate plates to travel toward the grounded electrodes. As in the case of the Cottrell precipitator, once the charged particles touch the grounded electrode, they naturally lose their charge to it and are retained only by their own natural adhesiveness or as is sometimes the case, in unusual circumstances of particularly dry, non adhesive dusts, are retained by a film of adhesive oil which has been sprayed on the precipitator element.

This type precipitator can effectively remove practically all particulate airborne contamination from the air stream, and at the same time control ozone to beneficial quantities. It has the further advantage of employing much lower voltages and, therefore, tremendously simplifying the power supply question.

Beginning with the termination of the last war, the application of this type of precipitation to ventilating systems has become increasingly popular, due to its many proven benefits. Obviously, the removal of soot, dirt and smoke before it collects on electrical equipment and controls is a tremendous help in reducing maintenance and preventing shutdowns. In the steel industry, the electronic air cleaner is widely used for the protection of mill motors and switchgear by eliminating the accumulation of airborne dirt on windings and contacts.

In addition to the protection of plant equipment, the electronic air cleaner contributes to employee welfare by reducing the danger of infection due to airborne bacteria.

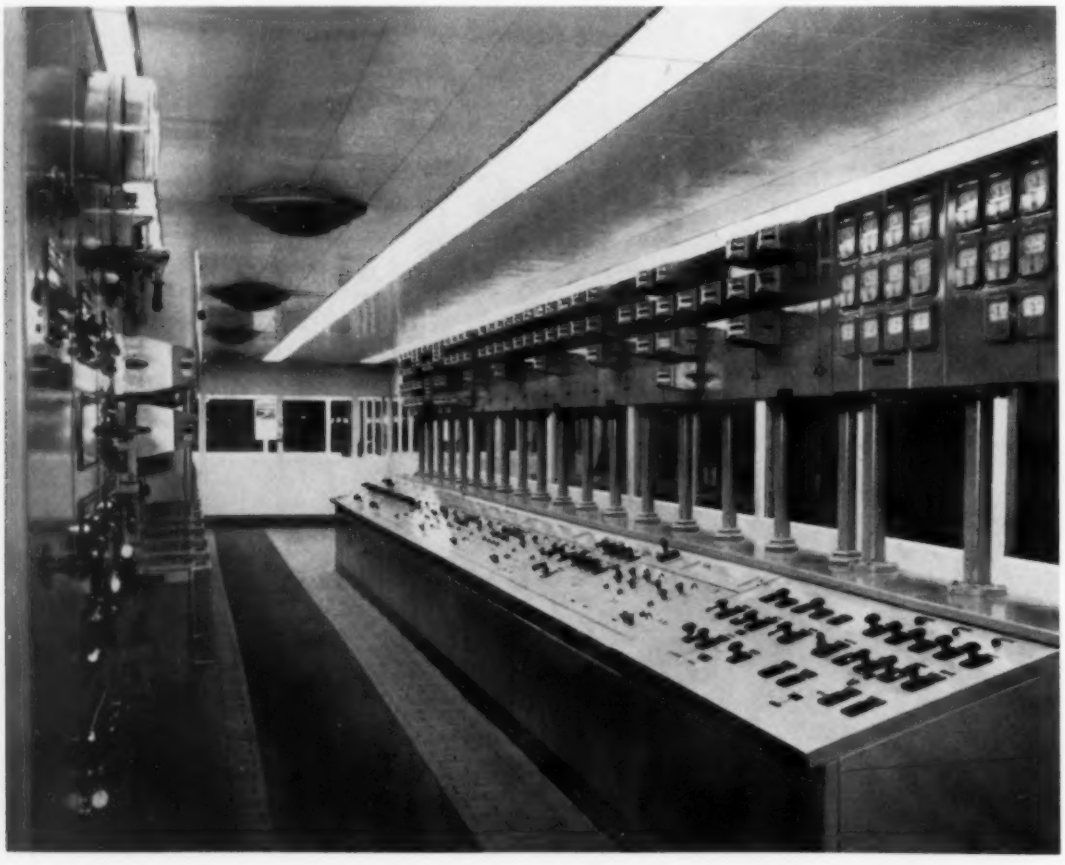


Figure 4 — A constant circulation of electronically cleaned air to this mill motor control room at Weirton Steel Company prevents the ink from clogging on precision recording instruments, protects delicate electrical contacts and guarantees more efficient operation during the distribution of power.

Studies made in England and published in the "Journal of the Institution of Heating and Ventilating Engineers" (British counterpart of A.S.H.&V.E.) in June 1951, found that electrostatic precipitators were very effective in removing airborne bacteria. Dust-borne organisms, sprayed cultures and prepared spore suspensions were used in the tests made at the Medical Research Council's Environmental Hygiene Research Unit, from Harvard Hospital. To quote from the summary of the journal's report: "It was found to be relatively easy to remove over 99 per cent of bacteria-carrying particles of these types from the air while still maintaining a reasonable rate of air flow through the cleaner."

The electrostatic filter has now become available for very practical applications in anything from a dwelling place to the largest skyscraper, or from a small instrument laboratory to the large installations in steel mills. In fact, anywhere where ventilated air is moved through a duct, it may be effectively filtered of practically all contaminants that are particulate in nature.

The detailed type and size of an electrostatic filter for any given application depends entirely upon the efficiency requirements. For ordinary ventilating purposes, the removal of 90 per cent of all airborne dust is considered practical. If, however, the dust is toxic, radio-active or for any other reason dangerous, the size of the filter can be increased to a point where practically perfect filtering is realized, so nearly perfect in fact, that only very elaborate techniques can be used in rating the filter. For instance, commercial 90 per cent efficient filters are considered adequate for ventilating systems in homes, buildings, mill motor rooms, textile mills, telephone switch rooms, etc., where the airborne contaminants are more nuisance than dangerous. Higher degrees of efficiency are required in biochemical or pharmaceutical applications, and finally for the protection of both military and civilian personnel from deadly airborne virus or radio-active dusts. Electrostatic filters are now under development that do a practically perfect job.

In order to present a more significant picture, it may

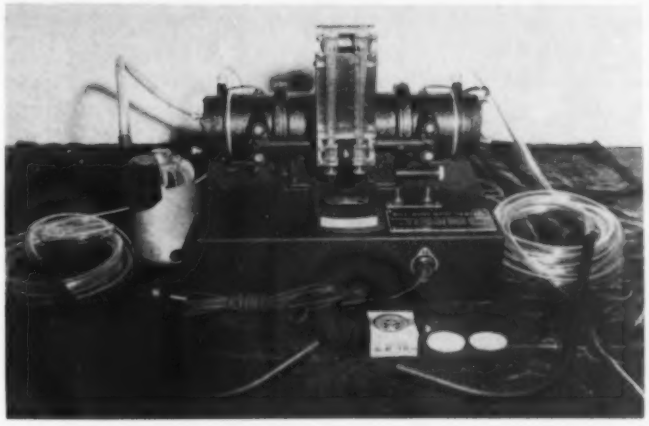
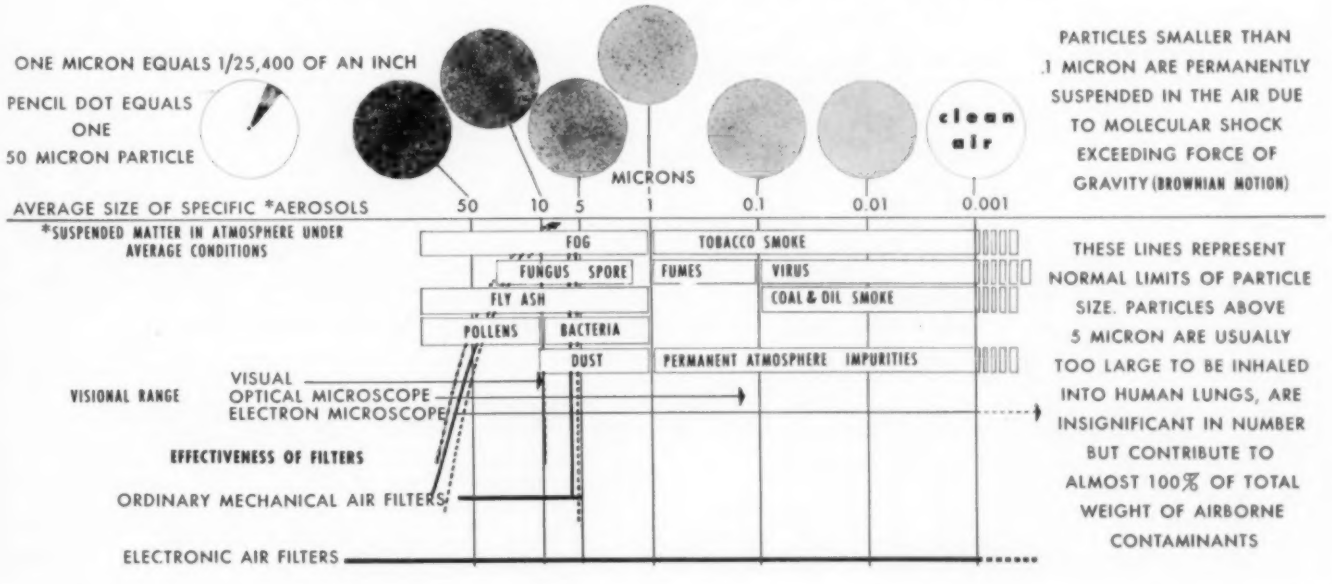


Figure 5 — This instrument accurately measures the efficiency of all types of air filters in ventilating systems.

be well to review current methods of determining filter efficiencies. For mechanical maze or impingement type filters, it is customary to introduce a synthetic dust, such as fly-ash into the test air stream. Then by drawing a sample from the air stream immediately in front of the filter being tested and filtering it through a close fibred paper or porous stone which is carefully weighed before and after the sampling, the weight of dust per cubic foot of air is determined. A similar sample is then taken on the downstream side of the filter being tested, and the difference in the weights represents the amount of dust retained on the test filter or its efficiency, which is expressed by the formula $\frac{W_1 - W_2}{W_1} \times 100$ where W_1 is the weight of dust per cubic foot of air in the upstream sample and W_2 is the weight of dust per cubic foot of air in the downstream sample.

However, since the electrostatic filter is effective in removing much finer particles which have very little weight, a true picture of its efficiency is difficult if not impossible, to obtain by the weight method. Accordingly, Mr. Richard Dill of the National Bureau of Standards developed the "Dust-Spot Method" which is quite practical for measuring the efficiency of most electronic air cleaners.

Figure 6 — Sketch shows a particle size chart. 25,400 microns equal 1 in.



Although in this method synthetic test dusts or various smokes may be used, it is generally more practical to base the test on the natural contamination in the air. A measured sample of the air is drawn from the upstream side of the filter to be tested and is filtered through a close fibred paper such as No. 41 Wattman, until a smudge or black spot appears on the paper. Then a measured sample is similarly taken from the downstream side and filtered through a second paper until a spot appears on the paper. Then a measured sample is similarly taken from the downstream side and filtered through a second paper until a spot of equal density to the first spot is obtained. The filter efficiency is then represented by the ratio of the volumes of air necessary to produce spots of equal "blackness," and is expressed in the formula $\frac{Q_1 - Q_2}{Q_1} \times 100$ where Q_1 is the downstream sample volume and Q_2 is the upstream sample volume.

In the past, efficiency ratings on air filters could only be obtained in the laboratory. The size and weight of available test equipment as well as the length of time required in making an efficiency determination made it impractical if not impossible to test a filter under installed conditions. Recently, however, a portable test instrument has been developed that makes it possible to evaluate the efficiency of any filter under actual operating conditions. This instrument measures filter efficiency by the National Bureau of Standards Dust-Spot Method and is known as the "Dill Dust-Spot Tester."

Using the "Dust-Spot Method" with ordinary atmosphere, a mechanical filter might be expected to show from 20 to 30 per cent efficiency, while the same mechanical filter would show from 80 to 90 per cent efficiency by the weight method using generally accepted synthetic test dusts. This discrepancy may be explained by the fact that one half of the weight of airborne dust, taken as an average from 14 different industrial cities in the United States, is composed of particles whose size is slightly less than 1 micron. This portion of atmospheric dust would not be filtered out by the mechanical filter. The other half would be removed in inverse proportion to its size.

The small particles which contaminate the air are generally invisible to the naked eye. In size, these particles are measured in terms of microns; and 25,400 microns equal one inch. Over a smoky industrial city, a single cubic foot of air may contain from 200,000 to over four million such particles. The various dirt particles may include; (1) common bacteria—1 micron in diameter, (2) pollen—from 15 to 25 microns, (3) tobacco smoke—0.1 micron, (4) silica dust—1 micron. Yet the smallest particle the unaided eye can distinguish is about 10 microns in diameter. To more graphically illustrate the size of the fine particles which can be collected electrostatically, let us imagine we could magnify a micron sized particle up to the size of a fine pencil dot. By this same magnification, a penny would appear to be 625 ft in diameter or as large as a football stadium.

Once this fine dust has been collected on an electrostatic filter, means must be provided to remove and dispose of it. In most applications where the contaminant is ordinarily atmospheric dust, smoke or soot, it can be cleaned by simply spraying with hot water. Modern designs of filters are now available with built-in washing systems; so that it is only necessary for the attendant to open a water valve without entering ductwork to effectively clean the collected dirt from the cells. The frequency of this washing varies with the amount of dirt in the atmosphere, but usually varies from one week in extremely dirty locations to several months in cleaner places.

Air pollution has become a serious national as well as local problem and rightly so. Consider that man can live 30 days without food, 7 days without water, but not over 7 minutes without air, and the true importance of the air we breathe becomes apparent. Pure air will undoubtedly take its rightful place with pure food and pure water as an American heritage. The relatively slow progress in comparison to food and water is probably due to the fact that air is free and is, therefore, not appreciated.

There is a demand for copies of the following Yearly Proceedings:

1919 **1937** **1941**
1942 **1943** **1944**
1948

If your copies are not in use please get in touch with us.

ASSOCIATION OF IRON AND STEEL ENGINEERS, 1010 EMPIRE BLDG., PITTSBURGH 22, PA.

CURRENT AISE DISTRICT SECTION MEETING NOTICES

BIRMINGHAM SECTION

Monday, November 30, 1953 — Dinner 6:30 P.M., Meeting 8:00 P.M.

"Transformers for the Steel Industry," by E. E. Bauer, Assistant Manager Sales, Power Transformer Dept., General Electric Co., Pittsfield, Mass.; L. G. Levoy, Industrial Power Engineer, General Electric Co., Schenectady, N. Y.; and G. S. Thagard, Office Engineer, General Electric Co., Birmingham, Ala.

Thomas Jefferson Hotel, Birmingham, Ala.

▲

BUFFALO SECTION

Tuesday, November 10, 1953 — Dinner 6:30 P.M., Meeting 8:00 P.M.

"Generation Expansion of Niagara Mohawk System," by H. I. Howell, System Project Engineer, Niagara Mohawk Power Corp., Buffalo, N. Y.

Hotel Sheraton, 715 Delaware Avenue, Buffalo, N. Y.

▲

CHICAGO SECTION

Tuesday, November 3, 1953 — Dinner 6:15 P.M., Meeting 7:45 P.M.

"Use of Low Pressure Carbon Dioxide in the Steel Industry," by H. V. Williamson, Director of Research, Cardox Corp., Chicago, Ill.

Phil Smidt's Restaurant, 1205 N. Calumet Avenue, Hammond, Ind.

▲

CLEVELAND SECTION

Tuesday, November 17, 1953 — Dinner 6:30 P.M., Meeting 8:00 P.M.

"Cost Comparisons of the Open Hearth and Electric Furnace," by David D. Moore, Assistant Supervisor Engineering Ecomomics Division, Battelle Memorial Institute, Columbus, Ohio.

University Club, 3813 Euclid Avenue, Cleveland, Ohio

DETROIT SECTION

Tuesday, November 10, 1953 — Dinner 6:30 P.M., Meeting 8:00 P.M.

"New Blooming, Billet and Bar Mills," by A. F. Eisel, Chief Roll Designer, United Engineering and Foundry Co., Pittsburgh, Pa.

Dearborn Inn, Oakwood Boulevard, Dearborn, Mich.

▲

PHILADELPHIA SECTION

Saturday, November 7, 1953 — Dinner 6:00 P.M., Meeting 7:00 P.M.

"Lubrication Practices at Alan Wood Steel Company," by R. G. Leister, Lubricating Engineer, Alan Wood Steel Co., Conshohocken, Pa.

"Use of Models for Layout and Planning," by J. C. Montoro, Supervisor of Maintenance Cost Control, Lukens Steel Co., Coatesville, Pa.

Engineers' Club, 1317 Spruce Street, Philadelphia, Pa.

▲

PITTSBURGH SECTION

Monday, November 9, 1953 — Social Hour 6:00 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.

"Cerro Bolivar" — A movie on the new iron ore development by the Orinoco Mining Co. in Venezuela. Comments by Frank R. Burnette, Assistant Executive Vice President — Engineering and Raw Materials, United States Steel Corp., Pittsburgh, Pa.
and
"The Iron Horse Goes North" — A movie on the iron ore development in Labrador and Quebec. Comments by Morris A. Bradley, Director of Public Relations, The M. A. Hanna Co., Cleveland, Ohio.

Alumni Room, University Club, University Place, Pittsburgh, Pa.

▲

YOUNGSTOWN SECTION

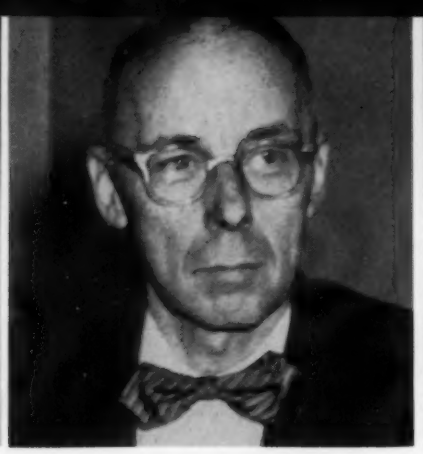
Monday, November 23, 1953 — Dinner 6:00 P.M., Meeting 8:00 P.M.

Paper to be announced later.

Mahoning Country Club, Girard, Ohio

KENNETH R. DANIEL
BIRMINGHAM DISTRICT SECTION

CLAYTON L. SQUIER
BUFFALO DISTRICT SECTION



LEONARD A. TERRY
CHICAGO DISTRICT SECTION

HARRY L. JENTER
CLEVELAND DISTRICT SECTION

AISE DISTRICT CHAIRMEN 1953-1954

KENNETH R. DANIEL was born October 13, 1913 in Shrewsbury, Mass. He was educated in Public Schools of Alabama and Tennessee, and graduated from University of Alabama in 1936 with degree of B.S. in Mechanical Engineering. Employed by American Cast Iron Pipe Co. in 1936, he served in melting, research, fittings foundry and engineering departments. He went on active duty, U. S. Army, in 1941, and was discharged with the rank of lieutenant-colonel at the war's end. He was appointed chief engineer, American Cast Iron Pipe Co. in 1948.

CLAYTON L. SQUIER was born in Madison, N. J. where he attended grade and high school. He graduated from Lehigh University with B.S. in E.E. in 1935 and in that year started with Bethlehem Steel Co., Lackawanna, N. Y. as engineer in electrical power department. He became electrical foreman, 12-in. bar mill, in 1940, and in 1946 became assistant to electrical superintendent, Lackawanna plant, the position he now holds.

LEONARD A. TERRY began work in the electrical department of National Tube Co., Lorain, Ohio, in 1917. He enlisted in the Navy in 1918. He graduated from Bliss Electrical School in Washington, D. C. in 1920, and returned to Lorain works as supervisor of electrical testing, becoming subsequently general foreman of maintenance. He served as chairman of the AISE Cleveland district section in 1932. In 1942, he was transferred to the Gary works as superintendent of power and electric department. He is a life member of the AISE.

HARRY L. JENTER was born in Trenton, N. J., and attended high school there. In 1917 he joined the Wire Division's Trenton works as a draftsman, and for the next few years alternately worked for the division and attended college. In 1926 he was graduated from Syracuse University with a degree in mechanical engineering and transferred to the Cleveland office. In 1928 he was made assistant foreman at the Newburgh Wire works. In 1932 he was transferred to the Cuyahoga works cold roll strip department and in 1934 was made general foreman. He became assistant superintendent of the works in 1935, general superintendent in 1939, and in 1942 transferred to the headquarters office as assistant to the vice president of operations. He resumed the post of general superintendent of Cuyahoga works a year later, was made chief engineer in 1950, assistant district manager in 1952, and district manager of operations in 1953.

PAUL LINDBERG, JR. started in the ceramic department of Timken Steel & Tube Co. in Canton, Ohio, in 1931, transferring to the mill metallurgical department in 1933, and remaining in this department until 1938. He then joined Copperweld Steel Co. in Warren, Ohio, as mill metallurgist, and became melting superintendent in 1944. In 1948 he joined McLouth Steel Corp., Detroit, Mich., as superintendent of melting at their Trenton plant.

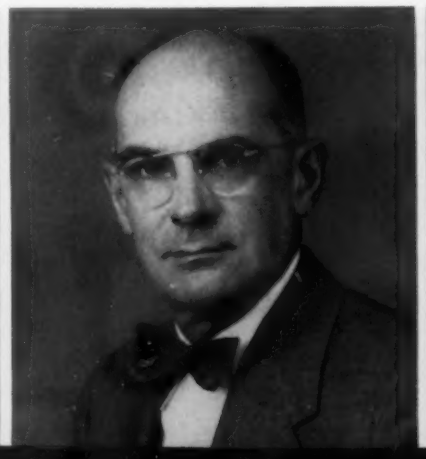
CLYDE S. CASSELS was born in Philadelphia, Pa., in 1905. He was educated in Philadelphia public schools and Drexel Institute of Technology, receiving a B.S. in C.E. in 1928. From 1928-35 he did miscellaneous construction work and has since held various positions in the engineering department of Henry Disston & Sons, Inc. Since 1945, he has been plant engineer with responsibility for plant and equipment acquisition, construction and maintenance.

T. M. FAIRCHILD was born in Portville, N. Y. in 1912. He graduated from Pennsylvania State College, School of Mineral Industries with a B.S. Degree in Ceramics. In that same year he was employed by Bethlehem Steel Co.'s Johnstown plant, where he has remained until the present time. He began his career as a ceramic engineer, and since has served as general foreman, brickmasons; assistant superintendent, yard department, and superintendent of the Franklin Mills. He is now assistant to general manager.

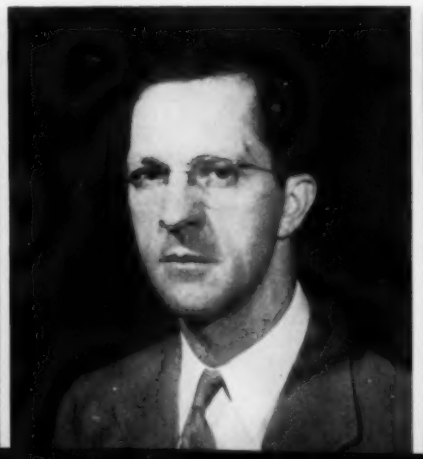
JOHN A. FERGUSON was born in Roker, England, in 1905. He attended Ohio State University, graduating in 1928 with a degree in electrical engineering. He worked for Pennsylvania & Ohio Power & Light Co. (now Ohio Edison Co.) from 1928 to 1932 as distribution engineer, then for the city of Youngstown, Ohio, from 1938 to 1940, as contract engineer on street widening program. From 1940-1942 he was electrical engineer for the Standard Oil Co. of Ohio. He joined Goodyear Tire & Rubber Co., Akron, Ohio, in 1942, supervising and inspecting electrical installations in connection with construction of a military aircraft plant. He went with Republic Steel Corp., Youngstown, Ohio district in 1942 as electrical engineer.

PAUL LINDBERG, JR.
DETROIT DISTRICT SECTION

CLYDE S. CASSELS
PHILADELPHIA DISTRICT SECTION

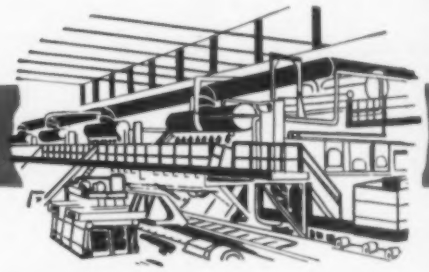


T. M. FAIRCHILD
PITTSBURGH DISTRICT SECTION

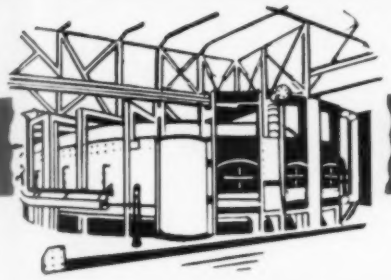


JOHN A. FERGUSON
YOUNGSTOWN DISTRICT SECTION

Ask the men *who operate them*

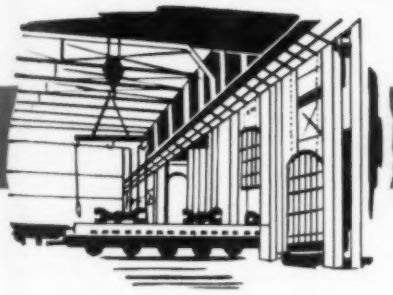


OPEN HEARTH · SLAB HEATING



ROTARY HEARTH · SOAKING PITS

ALL TYPES OF ANNEALING



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PICTORIAL REVIEW . . .

1953 AISE Convention

. . . Pittsburgh plays host for annual meeting — Daily techanical sessions attracted nearly 3,000 registrants — Tour of U.S. Steel Building an added feature . . .

The 17th floor of the William Penn Hotel in Pittsburgh, Pa., was the scene of one of the most interesting annual meetings ever held by the Association of Iron and Steel Engineers. Registration (1) from September 28 through October 1 reached a total of 2816 persons.

Authors and chairmen of the various technical sessions met in the Allegheny Room each morning at 7.45 A.M. The following attendees were photographed in the usual order: September 28 — Operating Practice Session (2): P. E. Thomas, William T. Hogan, S.J., Robert F. Kuhnlein, George Greene and R. H. Knapp. Electrical Session (3): H. B. Thacker, C. P. Hamilton, J. F. Headlee, Robert S. Bogar, and K. L. Johannsen. Mechanical Session (4): E. C. Hite, Ross Nebolsine, F. E. Robinson and G. S. Richardson. Open Hearth Session (5): Robert M. Jordan, G. H. Krapf, E. T. W. Bailey, and E. H. Cauger.

September 29 — Lubrication Session (6): Lowrie B. Sargent, Jr., Richard L. Berry, C. A. Bailey, James L. Duchene, Charles D. Spadone, and Andrew E. Cichelli. Materials Handling Session (7): M. D. Ayers, Erle M. Hays, E. T. Lorig, Carleton Lord, and J. D. Tyson. Electrical Session (8): George P. Dirth, D. C. McCrady, R. T. Lucas, Robert W. Graham, Wray Dudley, and J. S. Apperson.

September 30 — Electric Furnace Session (9): David D. Moore, A. K. Blough, and W. C. Wheeler. Rolling Mill Session (10): Charles F. Peck, Jr., J. N. Imel, Robert C. McMichael, Alex Montgomery, Jr., J. M. Bonetti, and William Rodder. Electrical Session (11): (seated) George A. Kaufman, H. H. Angel, and W. E. Schwabe, (standing) E. H. Browning and George E. Duerr. Combustion Session (12): (seated) E. A. Vierow, G. J. Gockstetter, and A. F. Kritscher, (standing) Frederic O. Hess, H. E. Raaflaub, and B. D. Barns.

October 1 — Lubrication Session (13): (seated) M. S. Clark, Joseph S. Aarons, W. M. Schuck, and Eldon L. Armstrong, (standing) Richard G. Warren, A. C. Keiser, Jr., and E. E. Perso. Combustion Session (14): C. J. Webster, R. A. Lambert, (standing) W. D. Rees, and Glen O. Carter. Standing roon only in the meeting rooms (15) was the rule throughout the 1953 convention.

One of the added attractions during the Pittsburgh meeting was a tour (16) through the recently completed United States Steel Corp. offices on Monday evening, September 28.

The ladies were entertained at a Welcome Party (17) at the Womens Clty Club on September 28 and at a luncheon at the Pittsburgh Field Club on September 29. They were also guests at the annual banquet on September 30. Mrs. F. S. Bloom served as general chairwoman, Mrs. John L. Young as honorary chairwoman, and Mrs. C. H. Williams served as vice chairwoman of the AISE Ladies Committee.

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PICTORIAL REVIEW . . . (continued)

. . . Old timers, new officers, paper s award, inspection trip highlig!nt four-day meeting . . .

On Tuesday evening, September 29, the AISE Old -- mers (members in good standing for 20 or more years) were gaily entertained at a fun-and-frolic session in the Urban Room (18).

During the Business Session, Monday, September 28, AISE president, John L. Young, announced the elected officers for the year 1954. They are (19): president, Eric L. Anderson, Bethlehem Steel Co.; first vice president, John H. Vohr, U. S. Steel Corp.; second vice president, W. H. Collison, Great Lakes Steel Corp.; treasurer, J. D. O'Roark, Weirton Steel Co.; and, secretary, Leonard Larson, Republic Steel Corp.

Seen at the speakers table reception, held preceding the banquet on Wednesday evening, September 30, were: M. A. Follansbee, Follansbee Steel Corp.; C. W. King, Allegheny Ludlum Steel Corp.; and H. B. Jordan, U. S. Steel Corp. (20); and, E. O. Burgham, Weirton Steel Co.; AISE founder James Farrington; and E. L. Anderson (21).

The winners of the AISE John F. Kelly Award for 1952 were announced at the annual banquet. Shown in (22) are: first place winner, J. L. Holmquist (standing, left); second place, E. H. Cauger (seated, left) and J. C. Stamm, Jr. (seated, right); and, third place, A. F. Kritscher (standing, right).

An inspection trip (23) on Thursday, October 1, through the Pittsburgh works of Jones and Laughlin Steel Corp. brought to a close the 1953 meeting.

John L. Young, AISE president, is shown with past president Charles L. McGranahan at the AISE board of directors meeting. Mr. McGranahan gave a very interesting report to the directors on his experiences in the French steel industry.

10 days

OR...

50 weeks

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For operations to which Stoody Castings are adaptable—*where severe wear is a major factor, where high operating temperatures and corrosion may present problems or where lubrication might be difficult*—Stoody Castings frequently provide an economical solution through reduction of down-time, lost production and parts replacement. Current uses of Stoody Castings include such parts as steel mill guide rolls, sewer pipe die rings and cores, extrusion cylinder liners, bushings and bearing surfaces, ball valve seats, wire flattening rolls and parts for mechanical seals.

A booklet describing these castings will be sent at your request. Our technical staff is placed at your disposal in determining the adaptability of Stoody Castings to your own requirements.

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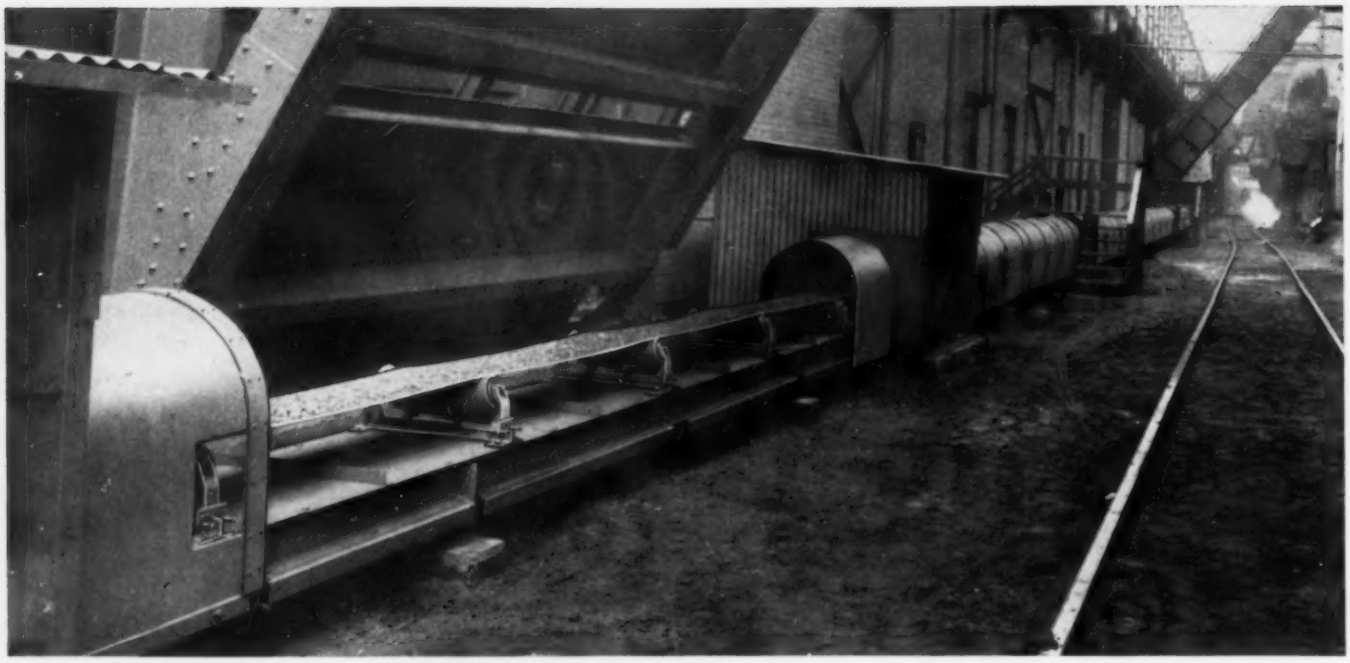

This Link-Belt belt conveyor (with part of cover removed) easily handles coke breeze for blast furnaces at steel mill.

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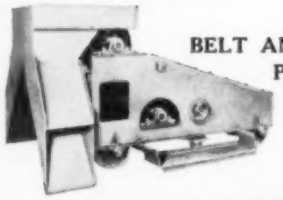

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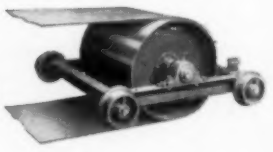

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Model 53 KLOZURE, with standard sealing element, applied to a shaft to protect the ball bearing.

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For your bearing protection Garlock KLOZURES offer you these important sealing-element advantages:

1. **Synthetic rubber sealing elements** for oil, grease, water, mild acids and alkalies at temperatures up to 300° F.
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3. **Teflon sealing elements** for strong acids.
4. **Choice of sealing element designs** with finger spring or garter spring for light, medium or heavy duty service at all speeds.
5. **All sealing elements** accurate and uniform in size, non-porous, tough, durable, non-abrasive and free-running.

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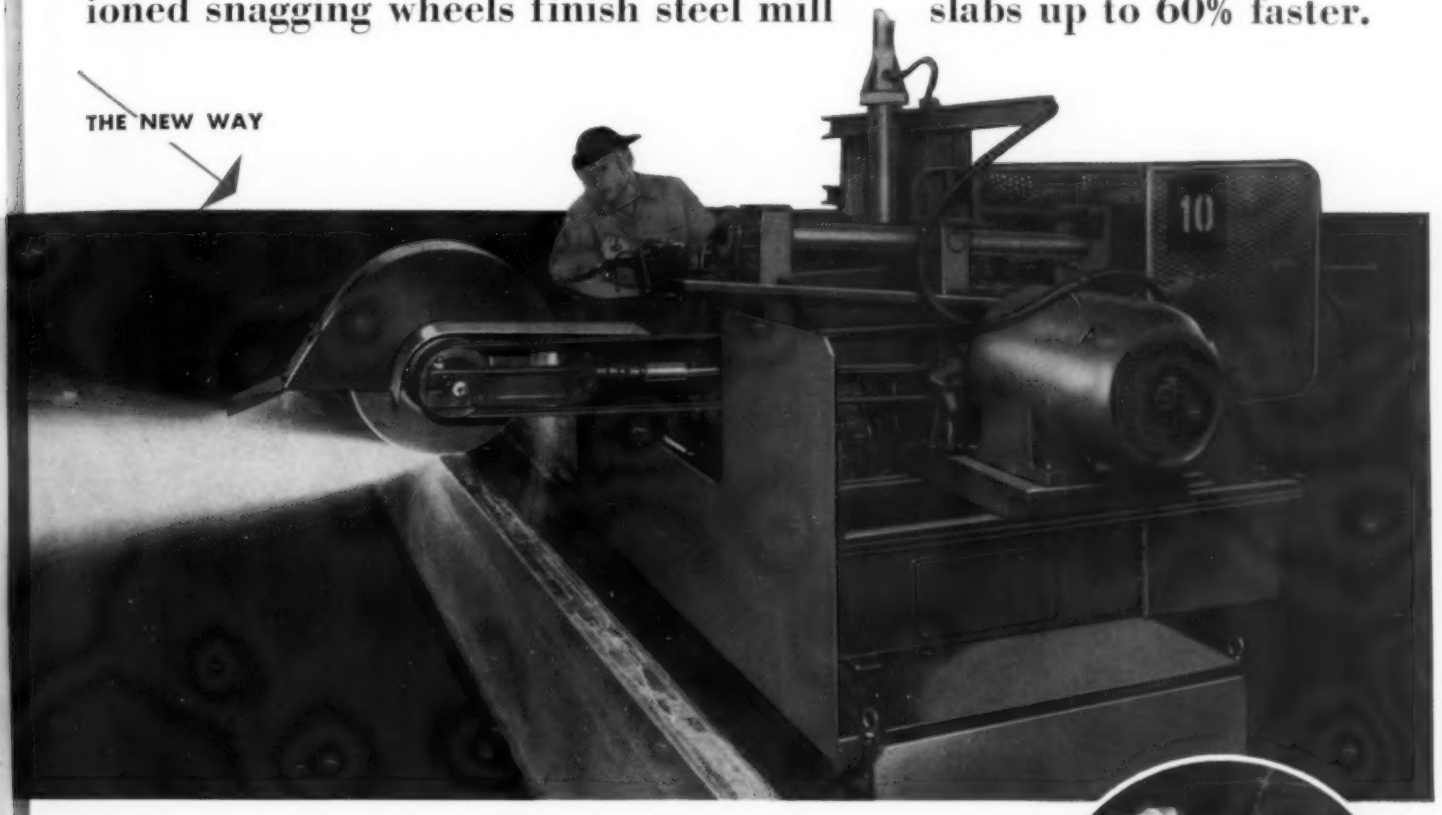
At the Rotary Electric Steel Company in Detroit, a battery of Mid-West Abrasive Automatic Grinding Machines are used in the conditioning of stainless and alloy steels. Blooms, billets and slabs are machine ground in the steel mill prior to the finish rolling operation.

done AUTOMATICALLY

Mid-West Abrasive Automatic Grinding Machines using fiber-cushioned snagging wheels finish steel mill slabs up to 60% faster.

THE NEW WAY

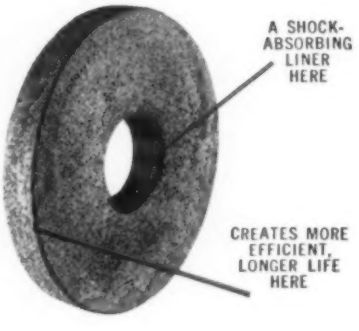


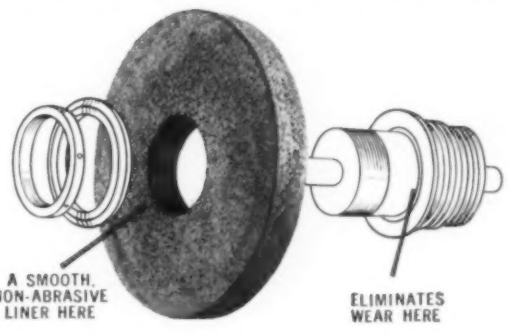
Designed with greater efficiency and better operating conditions in mind, Mid-West Abrasive's Automatic Grinding Machine replaces the old style hand-operated swing frame machine which required hard manual labor and resulted in high metal loss as well as physical hazards. With the Mid-West Abrasive system and mechanical transmitting mechanism, all operations are regulated from a main control panel. The machine is mounted on rails for steady, unrestricted movement along the length of the work. A counterbalancing mechanism maintains constant pressure of the grinding wheel on the work. The result is faster, more uniform grinding under much safer operating conditions.

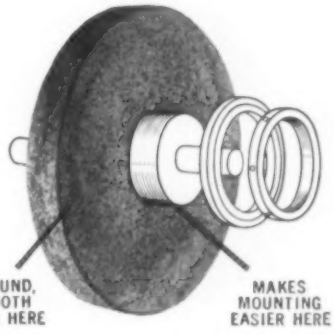
THE OLD WAY

Hand-operated swing frame grinder.

FIBER-CUSHIONED SNAGGING WHEELS







Write Mid-West Abrasive Company, America's foremost producers of snagging wheels, for complete information on modern grinding methods.

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Executive Offices: 510 South Washington Street, Owosso, Michigan
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BIRDSBORO, a great name in rolls, now offers you still another great roll . . . the BIRDSBORO "75" . . . a heat-resistant copper bearing roll designed especially for tough rolling requirements. Like all BIRDSBORO rolls, the "75" is "custom-built" to meet your specific requirements. For long range rolling efficiency and higher product quality, let BIRDSBORO's Individualized Roll Service go to work for you.

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J. L. HOLMQUIST WINS AISE PAPERS AWARDS

▲ THE prize winning Kelly Award for the best papers in 1952 were selected at the annual meeting of the Board of Directors, September 27. Winner of the first prize was J. L. Holmquist, director of research, Spang-Chalfant Division, National Supply Co., Ambridge, Pa., for his paper "Investigation of the Piercing Process by Means of Model Wax Billets." Mr. Holmquist has been one of the pioneers in the operation of using wax billets in the laboratory to determine how metal flows in the tube piercing operation. His studies have provided valuable data for tube mill operation. This paper was originally published in the December 1952 issue of the Iron and Steel Engineer.

Second prize also went to a paper published in the December 1952 Iron and Steel Engineer. This paper was "Operative Results of One-Way Fired Recuperative Soaking Pits," by E. H. Cauger, chief combustion engineer, Wheeling Steel Corp., Steubenville, Ohio and J. C. Stamm, Jr., who at the time of writing the paper was field engineer for the Wheeling Steel Corp. in Steubenville, Ohio. Mr. Stamm is now with Kaiser Steel Co., Fontana, Calif. This paper described the new soaking pits installed by Wheeling Steel Corp. at its Steubenville plant—pits have been a very important factor in the production of strip at this plant.

A. F. Kritscher won third place for his paper "High Temperature—High Speed Heating" which appeared in the March 1952 Iron and Steel Engineer. Mr. Kritscher at the time of writing the paper was development engineer, National Tube Division, United States Steel Corp., Pittsburgh, Pa. and has since been promoted to assistant chief engineer process development. This paper described the application of the principles of high speed heating to new types of heating units which have given better production and economy in operations.

There were many other excellent papers considered in the final selections. Runner-ups included a paper by Edgar Herold on "Rolling Characteristics of Various Steels" which appeared in January of 1952, a paper entitled "Electrical Laboratory in a Steel Corporation" which appeared in July 1952, a paper by Louis Moses entitled "Delivery of Torque to Rolls" which appeared in June 1952. Mr. Moses was also first place winner last year. Other runner-ups included Walter L. Keene, Fred K. Schefe, C. S. Lambert, K. S. Kuka, George B. Scheer, W. I. Lex, H. F. Jacquart, Frank Zipf. All of these papers were published in the Iron and Steel Engineer during 1952 and had been republished in the 1952 proceedings of the Association of Iron and Steel Engineers.

The Kelly Award carries prizes of $300, $200, and $100 for first, second and third place respectively. The award was established September 28, 1943 to honor John F. Kelly, managing director of the AISE from 1917 to 1934, and to perpetuate the memory of his achievements in the advancement of the Association.

The award is made each year by the Board of Directors of the AISE upon the recommendations of the editorial and executive committees of the Association.

Rules of the Award:

1. The Award shall be given annually to the author of the paper adjudged of greatest value in the advancement of engineering or operating practice in the iron and steel industry.

2. The entries for each judging shall be the papers published in the Iron and Steel Engineer during each calendar year, although some may have been presented at meetings in the previous year.

Voluntary contributions of papers not presented at meetings but published by the Association are also included in the judging.

3. To be eligible for the Award, the author must be directly employed in the iron and steel producing industry. The author need not be a member of the Association of Iron and Steel Engineers.

4. The Award shall be made at the annual fall meeting following the close of the calendar year.

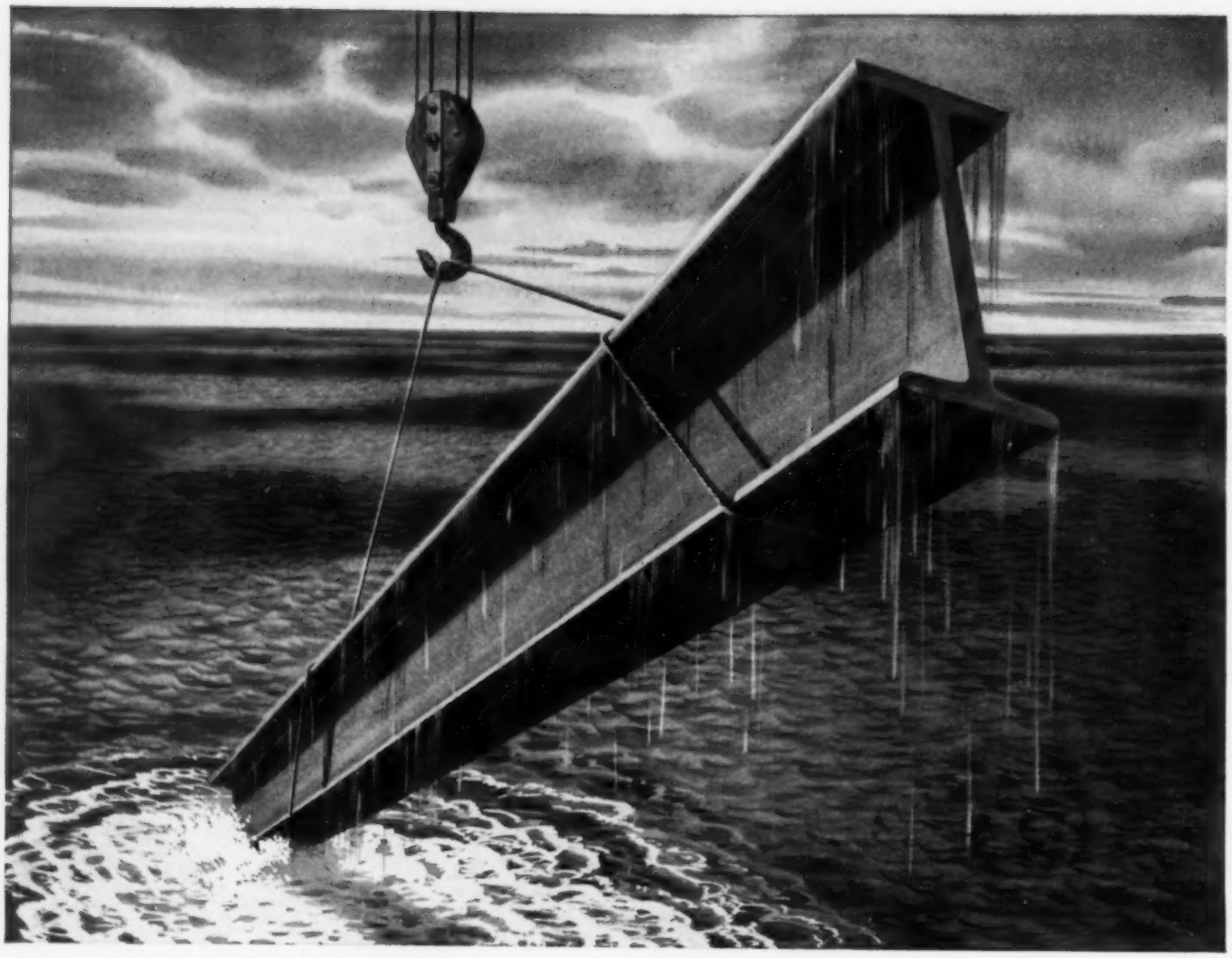
5. The Award shall be made by the Board of Directors of the Association on the recommendation of the executive committee of the Association.

J. L. HOLMQUIST

E. H. CAUGER

JAMES C. STAMM, JR.

A. F. KRITSCHER



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Higher in MgO, lower in impurities, this sea water *periclase* is the heart of Permanente 165 ramming mix.

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YOUR Kaiser refractory engineer will give prompt attention to your refractory problem—will offer, where desired, research, design and installation service to give you maximum production most economically. Write for descriptive literature on (1) Permanente 165, (2) the companion ramming mix, Permanente 84, and (3) Permanente Refractory Brick. Principal sales offices: *Chemical Division,* Kaiser Aluminum & Chemical Sales, Inc., 1924 Broadway, Oakland 12, California. First National Tower, Akron 8, Ohio.

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Basic Refractory Brick and Ramming Materials

Better brick...another secret of more steel!

THE PROVED SUPERIORITY of Permanente Basic Brick is the result of more than 10 years experience in producing basic brick specifically designed to give you better performance.

Many of the nation's largest steel producers rely on Permanente Basic Brick to give them longer life in service, less downtime for replacement and repair, and higher tonnages. Among its quality advantages are:

• *Pre-shrunk, accurately-sized periclase grains derived from sea-water magnesia* • Ceramic bond achieved through solid phase reaction; no appreciable liquids at operating temperatures • High refractoriness • Maximum density • Resistant to slag attack • High hot load strength • Maximum resistance to abrasion • Superior spall resistance • Great volume stability • Clean edges; accurate dimensions.

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PA (Permanente Periclase "A") brick burned for open hearth and electric furnace bottoms. Low in iron, chrome free, maximum MgO in bottom.

PCA, PCA-MC (Permanente Periclase-Chrome "A") brick, plain and metal-encased for open hearth end walls, front walls and uptakes. Metal-encased for electric furnace sidewalls. High in MgO. Outstanding all-purpose refractory.

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Installation service at no extra cost.

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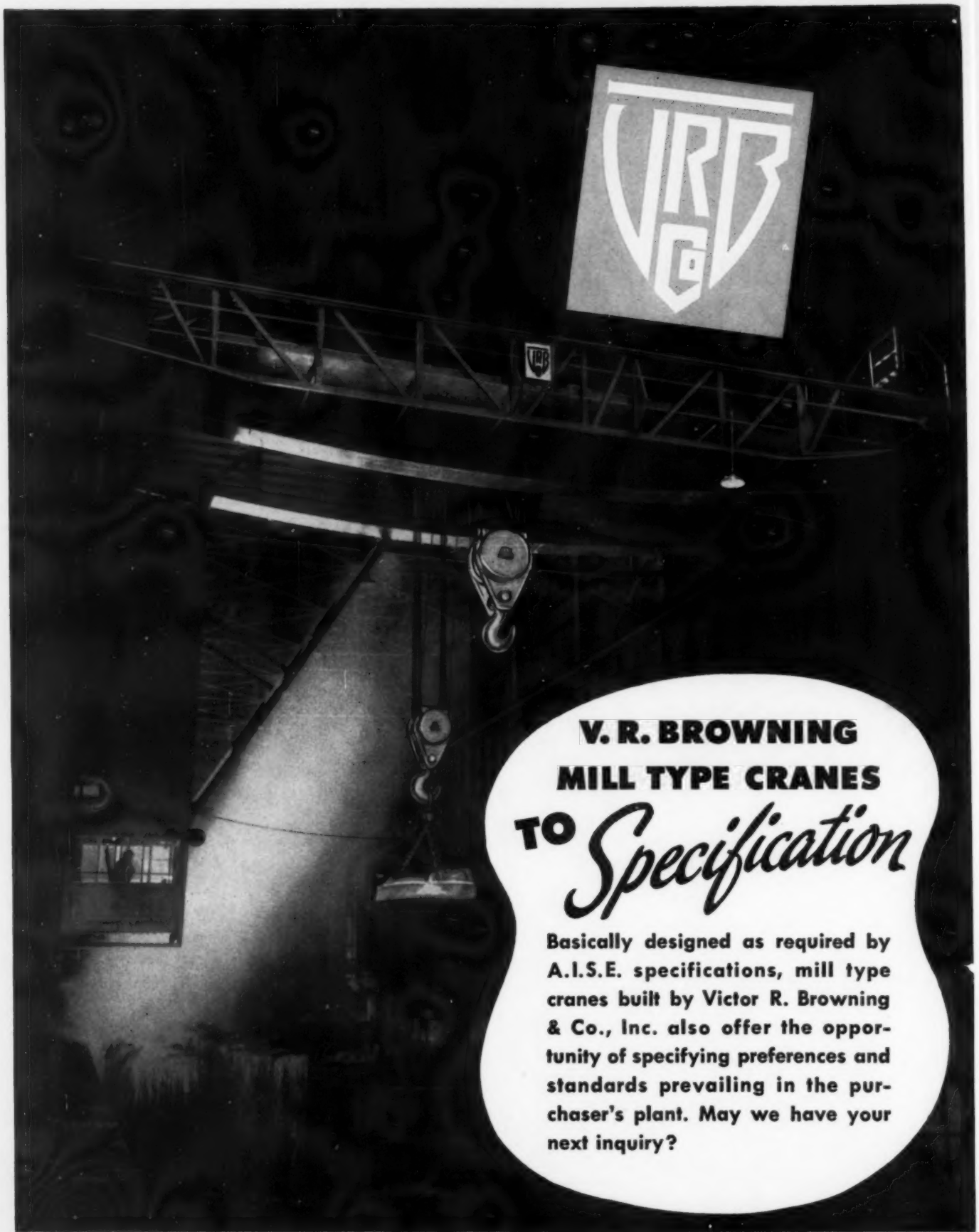
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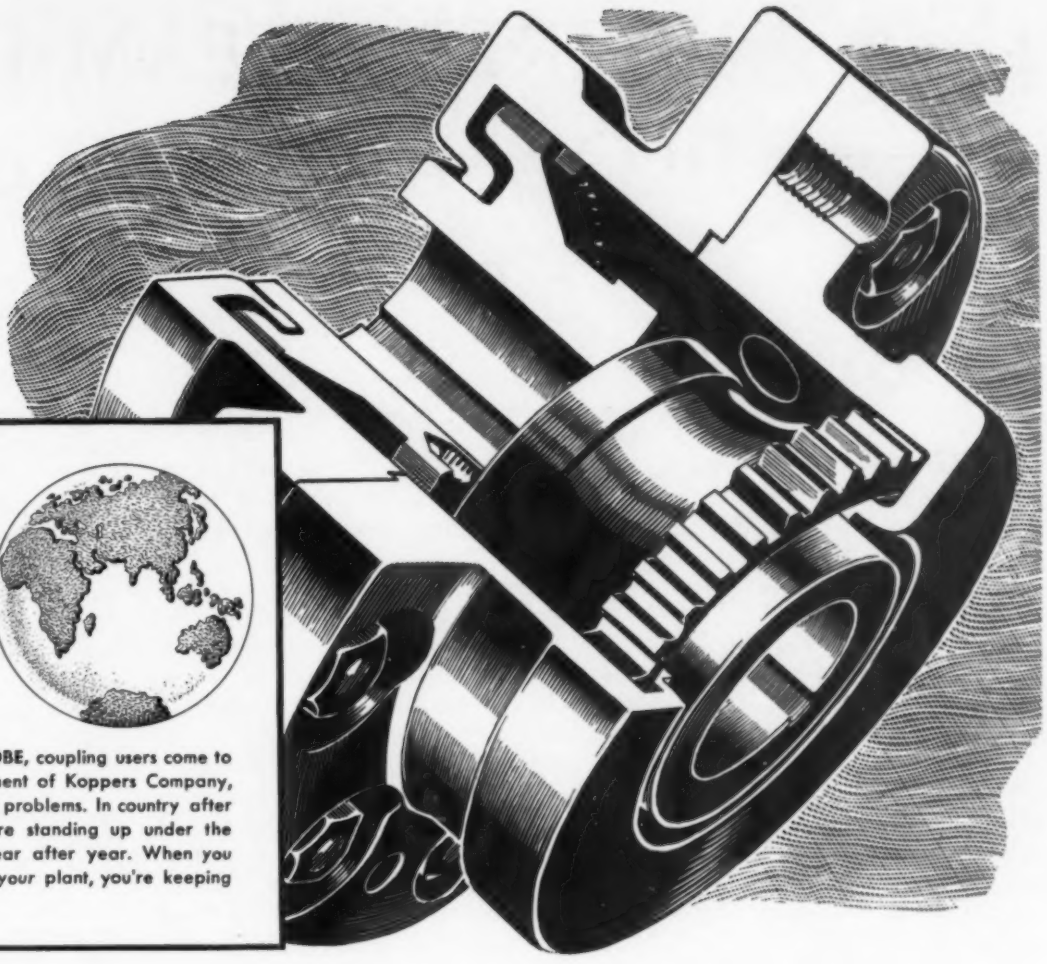
Designers and Builders of Electric Overhead Traveling Cranes and Hoists and Electric Revolving Cranes



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J & L RETIRES STEAM-DRIVEN BLOOMING MILL

▲THE old steam engine of the world record-breaking blooming mill at J&L's Aliquippa works was retired on September 8, 1953 at 8 a.m., after 41 years of service and production of almost 43,500,000 net tons of blooms.

Its successor—an all-electric drive and a virtually new mill—began operations on September 15 at 10:30 p.m., after a record-breaking installation which took only 7 days, 14½ hours. This was more than two whole days ahead of the schedule set up for the changeover.

The new drive consists of four 3,000-hp motors together with supplementary equipment. The mill itself has been substantially rebuilt to incorporate new housings and other equipment.

The work on the changeover began in February of 1952. No interruption occurred in the operation of the blooming mill until the new motors were installed on the location of the old steam engine. This installation was begun on September 8, and 9 days, 20 hours were allotted for the job.

Through teamwork and close planning, this schedule was bettered by more than two days. The last ingot on the old steam-driven mill was rolled at 8 a.m. on September 8—and the first ingot on the "new" mill was rolled at 10:30 p.m., on September 15.

The retired steam-driven mill holds the world's record for the number of 5-ton ingots rolled in one 8-hour turn. In establishing that record, it rolled 522 ingots in March, 1949, to break its own previous record which was set during World War II.

Other records set in March, 1949, by this mill are: 77 ingots in one hour, 6,538 ingot tons in 24 hours, 42,205 ingot tons in a week, and 183,728 ingot tons for the month.

The old steam engine, a Mackintosh-Hemphill job, powered the mill to roll its first ingot on January 23, 1912. Installation had begun in 1909. The engine was one of three "sister" engines. The other two went to Crucible Steel and the Duquesne works of U. S. Steel Corp.

When a new blooming mill is installed, the old one usually is kept in operation while the new one is set up on another site nearby. This was not done with this one. In the last days of operation of the old steam engine, workmen had been drilling in its concrete foundation, removing as much as possible of the 46 cubic yards of concrete that had to come out to accommodate the new motor base.

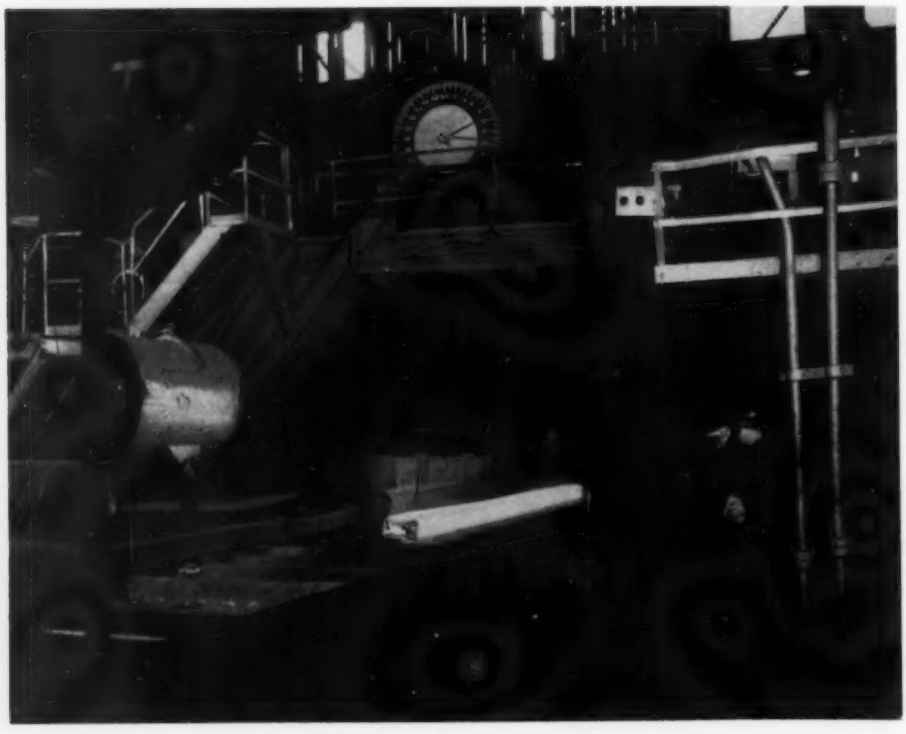
When shutdown time came on September 8, the big steam engine was cut in half with acetylene torches, severing its sides along lines drawn days before in bright green paint. Approximately two hundred workmen per turn worked on the project site in Aliquippa works' north mills to make the changeover.

The new mill was moved into place with the assurance that all couplings, conduits, pipes and other fittings would fall into place. Construction engineers made sure of this by assembling the mill complete, on a temporary foundation out-of-doors near the old mill, ahead of time.

The new main drive is made up of four 3,000-hp motors. Each pair of motors in tandem drives one of the two mill rolls. The new electric drive is expected to give the mill an even faster rolling rate than it had in the past. The mill's new drive is able to change from a speed of 70 rpm in one direction to 70 rpm in the opposite direction in one second.

To furnish power to the driving

Figure 1 — The old steam engine of this world record-breaking blooming mill at J & L's Aliquippa works was retired on September 8 and an all-electric drive in a virtually new mill was installed in record-breaking time. The old blooming mill held world records set during and since World War II.



The palm tree that grows in Ohio

They planted it a year ago.
Leading steel publications covered the story:

"New All-American Lubricant For Cold Rolling Operations"

That's how The Ironsides Company of Columbus, Ohio, announced the first successful replacement for palm oil.

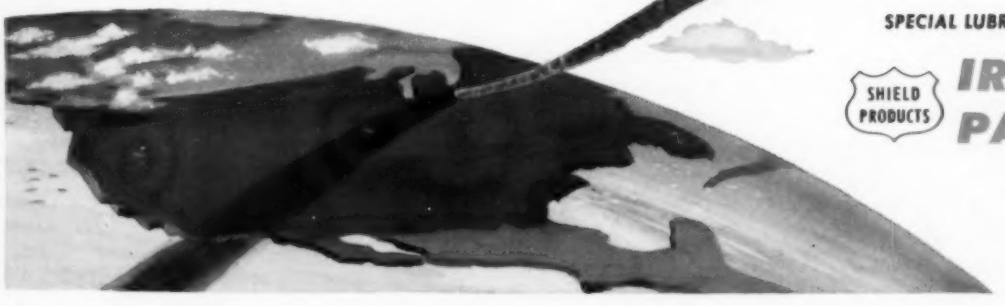
Instead of relying on palm trees—half a world away, tin plate producers now have a "palm tree" right in their own back yard.

Palmoshield looks, feels and acts like palm oil; requires absolutely no changes in mill operation. Already most of the major tin plate mills in this country and Canada are using Palmoshield for regular mill operations or for production test runs.

. . . and grows and grows and grows!

Production records set with Palmoshield: Recently a leading steel company, over a run of 20 consecutive shifts, increased production 15% over the average output with imported oil. No additional investment, no increase in manpower, and no changes in mill operation. Yet 115 tons of steel were rolled for every 110 before. One company broke the single-shift record, and still another broke both 8-hour and 24-hour records.

Backed by 60 years of specialization: Palmoshield is the result of Ironsides' sixty years of specialized research in the field of scientific lubrication. For your own lubricating problems, call or write The Ironsides Company, 270 West Mound Street, Columbus, Ohio.



SPECIAL LUBRICANTS and PRESERVATIVES

SHIELD PRODUCTS

IRONSIDES PALMOSHIELD

motors, a main motor-generator set has been installed in the enlarged engine room. This consists of four generators, each producing 3,000-kw of 750-volt direct current.

The flywheel on the motor-generator weighs 111 tons and was brought into the building on a special railroad car built with a frame of 36-in. I-beams, the largest made. The motor-generator is run by a 9,000-hp driving motor.

Seven new transmission towers have been installed at the Aliquippa works to bring in power for the new blooming mill drive from Phillips Power Station of Duquesne Light Co. The lines carry 69,000 volts. A step-down transformer converts this to 6600 volts for use in the mill.

To supply clean air in the motor room, it is pressure-ventilated with 54,000 cfm of air, brought in through a wet cell washer, then through an electrical precipitator. There are also three 68,000 cfm fans to ventilate the motor generator and three others, each 63,400 cfm, for the main driving motors.

To provide space for the new equipment, the existing engine room was widened 20 ft and lengthened 16 ft. The roof, too, was redesigned and rebuilt over the whole building. All of this is steel construction with brick facing. There is also a new 100 x 40 ft building for the fans, pumps, and locker rooms for workmen, and a 25 x 40 ft building for the hydraulic equipment of the mill.

Figure 2 — View from pulpit, or control tower, of blooming mill at J & L's Aliquippa works. A new all-electric drive in a virtually new mill was installed in record time.

Maintenance men from every department in the Aliquippa works were trained for this special job. They met in regular sessions in which each step was "rehearsed" down to the last detail.

Work on the design and specifications of the new drive was begun by J&L and General Electric Co. engineers ten years ago. The motors and much of the auxiliary electrical equipment were built by General Electric Co. and the mill housings by Mesta Machine Co. Marion Coal Co. did the concrete cutting and placing.

HIGH ALLOY CASTINGS RESIST HIGH TEMPERATURES

▲ BECAUSE of the ever-increasing severity of modern industrial processes, engineers must now rely on materials especially suited to vigorous conditions of high temperature and pressure. According to the Alloy Casting Institute, technical association of high alloy foundries, these conditions are making new demands on metallic components of equipment used in oil refining, heat-treating, gas and steam turbines, jet aircraft, and chemical processing.

The design of such equipment is complicated by hot gas corrosion of metal parts used for continuous or intermittent service above 1200 F, where almost any atmosphere tends to be corrosive. Hot gas corrosion causes progressive scaling which can eventually reduce the sectional area of an exposed structural element, with consequent loss of load-carrying ability.

Engineers not actively concerned with high temperature design may be unfamiliar with the properties of a group of alloys that retain mechanical strength at high temperatures, and also resist corrosion from various types of hot gas. These are the chromium-nickel-iron cast high alloys (greater than 8 per cent alloy content), which are divided by the Alloy Casting Institute into corrosion-resistant and heat-resistant groups. In the heat-resistant group, twelve cast alloy compositions are recognized as standard (Alloy Casting Institute "H" series), and within this general classification, there are three distinct types:

(*Please turn to page 134*)

Four Straight-line Line-O-Power Drives operating screw conveyors at petro-chemical plant in Oklahoma.

equipped with FOOTE BROS. Duti-Rated LIFETIME GEARING

This Trademark Stands for the Finest in Industrial Gearing

solve your space and weight problem . . . with LINE-O-POWER*

When limited space governs a reducer's size — when weight is a critical factor — LINE-O-POWER is your drive.

Line-O-Power Drives are smaller, lighter, more compact — yet offer almost any reduction you need — because Duti-Rated Lifetime Gearing assures maximum load-carrying capacity in minimum space. Newly-developed Duti-Rated Gears have high hardness, extreme accuracy — permit *big* savings in size and weight.

Longer life — higher efficiency — quieter operation — these are Line-O-Power advantages, brought about by Duti-Rated Lifetime Gearing, unmatched in the industrial gear field.

Sturdy Line-O-Power Drives are available for prompt delivery — in straight-line or right-angle design — with foot or flange mountings — for horizontal or vertical service. Talk over your requirements with the Foote Bros. representative, or write for helpful information.

*REG. U. S. PAT. OFF.

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Hygrade Drives

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FOOTE BROS.

Better Power Transmission Through Better Gears

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World's largest builders of world's largest cranes

ALLIANCE PLAYS A VITAL ROLE

450/75/20-TON, 4-GIRDER LADLE CRANES

When the engineers from the Construction Engineering Bureau of the United States Steel Corporation were in the market for the world's largest ladle cranes for Fairless Works, they consulted The Alliance Machine Company, whose experience and know-how qualified them for this important task.

One of the cranes Alliance designed, which is now operating in the Fairless Works, is this 450-ton ladle crane. Having a 69'6" span, this crane is equipped with a 2-motor, synchronized worm drive and double-drum interlocked type main hoist. The synchronizing shaft employed in the gearing scheme not only eliminates undesirable ratchet gears, but makes possible an additional safety feature in case one hoist motor fails. Under this condition, both worms are driven by the remaining motor. All gearing functions continue as though operated with two motors. In case of hoist motor failure on the conventional drive **without** the synchronizing shaft, hoisting is accomplished by **only one** set of gears, thus imposing a double load on active gearings, as the second drum is then driven through interlocking drum gears.

Hoist gearing is so proportioned that full crane capacity can be lifted by one motor without exceeding the quarter-hour rating.

Drum gears and pinions of the main hoist have precision-cut, single-helical teeth. This feature, in cooperation with the worm drive, provides vibrationless operation on either high- or low-speed hoisting and lowering.

All gears of this new Fairless Works crane are fully enclosed and operate in a bath of oil, assuring long life and low maintenance. The 4-part safety rope system affords the highest degree of safety in rope reeving.

This crane is equipped with a 5-story cab, the operator's compartment being air-conditioned.

Consult Alliance Machine Company engineers when you have a heavy material handling problem.

THE *Alliance* MACHINE COMPANY

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H. J.
Here's a really fantastic letter!
P.W.

BANNER TOOL COMPANY

BANNER tools DETROIT — *Fine* TOOLS FOR INDUSTRY

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DETROIT 12, MICHIGAN

June 16, 1952

Cities Service Oil Co.,
3049 E. Grand Blvd.,
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Attention: Mr. P. E. Watts

Dear Sirs:

We called upon the services of your lubrication engineer, Mr. A. J. Blake, in reference to a serious staining condition which we were having with our soluble oil. He analyzed this condition and recommended one of your Chillo Oils. This oil was tried and the rust condition eliminated to our satisfaction.

To our surprise on his next visit he was dissatisfied with our tool life and suggested we use a soluble oil called "Chillo A". Now not only do we have clean machines, but tool life has been increased 20%! While in our plant he asked permission to "look around", which, of course, was granted.

We were using a tapping compound with precision ground taps in order to hold to close tolerances. We did not consider tap breakage excessive but the removal of broken taps was sometimes rather expensive. He recommended we use "Chillo 10Z". Then came the surprise of our lives! With Chillo 10Z we have gone to commercial ground taps (a 300% savings) and can still hold our same tolerances, with a sharper thread, increasing tap life a minimum of 20% plus eliminating expensive removal of broken taps!

We also have a production stamping job which required a new set of dies every month. On his recommendation we tried Chillo 10Z with these dies. Now our die life has increased to at least two months...a saving in die life of 100%, disregarding labor costs. We also increased production 200% per die sharpening!

We tried the same oil on our broaching operation and found that instead of making two cuts we can get the same results now with one. We were using one of your competitors' hydraulic oils and you told us it was a "good oil" and would give us satisfactory performance. BUT, GENTLEMEN, WITH THE EXCELLENT SERVICE YOU HAVE GIVEN, PLUS THE TIME AND MONEY SAVED, YOU MAY REST ASSURED THAT ALL OF OUR LUBRICATING REQUIREMENTS WILL BE PURCHASED FROM YOU.

Yours very truly,

BANNER TOOL COMPANY

S. F. OLESAK

SFO:sd

(*Continued from page 130*)

A. Iron-chromium castings containing up to 30 per cent chromium and under 7 per cent nickel (HC and HD). Type HB alloy, containing only 18 per cent chromium and useful only up to 1500 F, is sometimes also included in this group. These ferritic alloys offer excellent resistance to oxidation and sulphur-containing atmospheres, although they have moderate hot strength.

B. Iron-chromium-nickel castings containing 18 to 32 per cent chromium, 8 to 22 per cent nickel, with higher chromium than nickel content (types HE, HF, HH, HI, HK, and HL). Partially or fully austenitic, these alloys have greater high temperature strength and ductility than the straight iron-chromium group, will withstand greater loads and temperature cycles, and can be used in sulphur-bearing, oxidizing and reducing atmospheres.

C. Iron-nickel-chromium castings containing from 30 to 70 per cent nickel and 10 to 20 per cent chromium (types HT, HU, HW, HX). These alloys are fully austenitic, maintain excellent hot strength in applications up to 2100 F, and have good life under rapidly fluctuating temperatures. They withstand reducing and oxidizing atmospheres, do not carburize excessively, and do not take up nitrogen in a nitriding atmosphere. The high nickel content makes this group unsuitable for use in atmospheres containing substantial amounts of sulphur.

Most of the chromium-nickel-iron cast alloys suitable for high temperature service also withstand the effects of one or more varieties of heat treating atmospheres — oxidizing, reducing, and various types of sulphur-bearing fuel gas environments.

From the many industrial applications in which the three basic groups of heat resistant alloy castings have been successful, the following examples have been chosen to show how the alloys provide various combinations of mechanical properties and hot gas corrosion resistance.

RECUPERATORS

Typical of conditions in many types of heat treating equipment is the combination of hot gas and moderate stress conditions found in recuperator installations. These recuperators are usually installed in waste gas flues, to recover the heat to be used for preheating of air. The waste gases to which the alloy may be exposed will produce every variety of hot gas corrosion. To meet such demands, a heat resistant material of moderate strength, but with high corrosion resistance, is necessary and an alloy from Group A is indicated. For the particular application considered here, strength requirements indicated an alloy of somewhat better mechanical properties than type HC; so type HD was suggested by the Duraloy Company, Scottdale, Pa., which made the castings. This alloy, containing 28 per cent chromium and 5 per cent nickel, can be used for applications where moderate stress is encountered up to 1400 F, and for somewhat lighter load-bearing duties up to 2000 F. Because of the high chromium content, type HD resists oxidation and is especially useful in high sulphur-containing atmospheres. The castings illustrated measure 66 in. long and 5 to 8 in. wide, and are installed in recuperator banks varying from four to 40 castings.

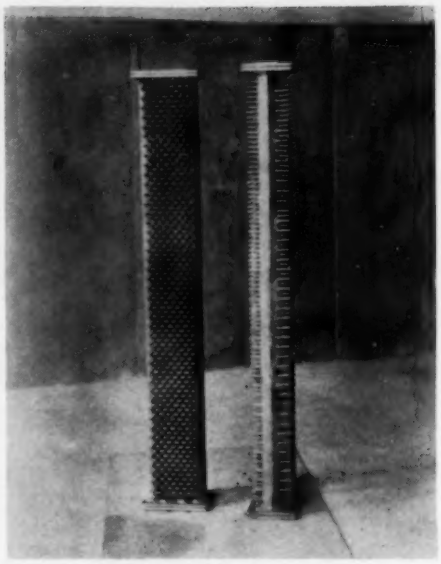


Figure 1 — HD alloy recuperator castings, up to 66 in. long, 5 to 8 in. wide, are required to withstand practically every type of hot gas corrosion.

ANNEALING RETORTS

An example of the value of proper alloy selection, and its effect on performance, is provided by the annealing retorts cast and fabricated by the Electro-Alloys Division of the American Brake Shoe Co., Elyria, Ohio. Used to protect high-speed tool steel from combustion products in hood-type furnaces, heated by high sulphur-content anthracite producer gas, these retorts were formerly made of seamless carbon steel tubes. Performance was unsatisfactory.

In the annealing process, the furnaces containing the retorts are preheated to 1650 F and held at this temperature for 10 hours. The temperature is then dropped to 1400 F, held for two hours, dropped to 1375 F and held for three hours, after which the stock and retorts are furnace cooled. The total cycle takes 30 hours.

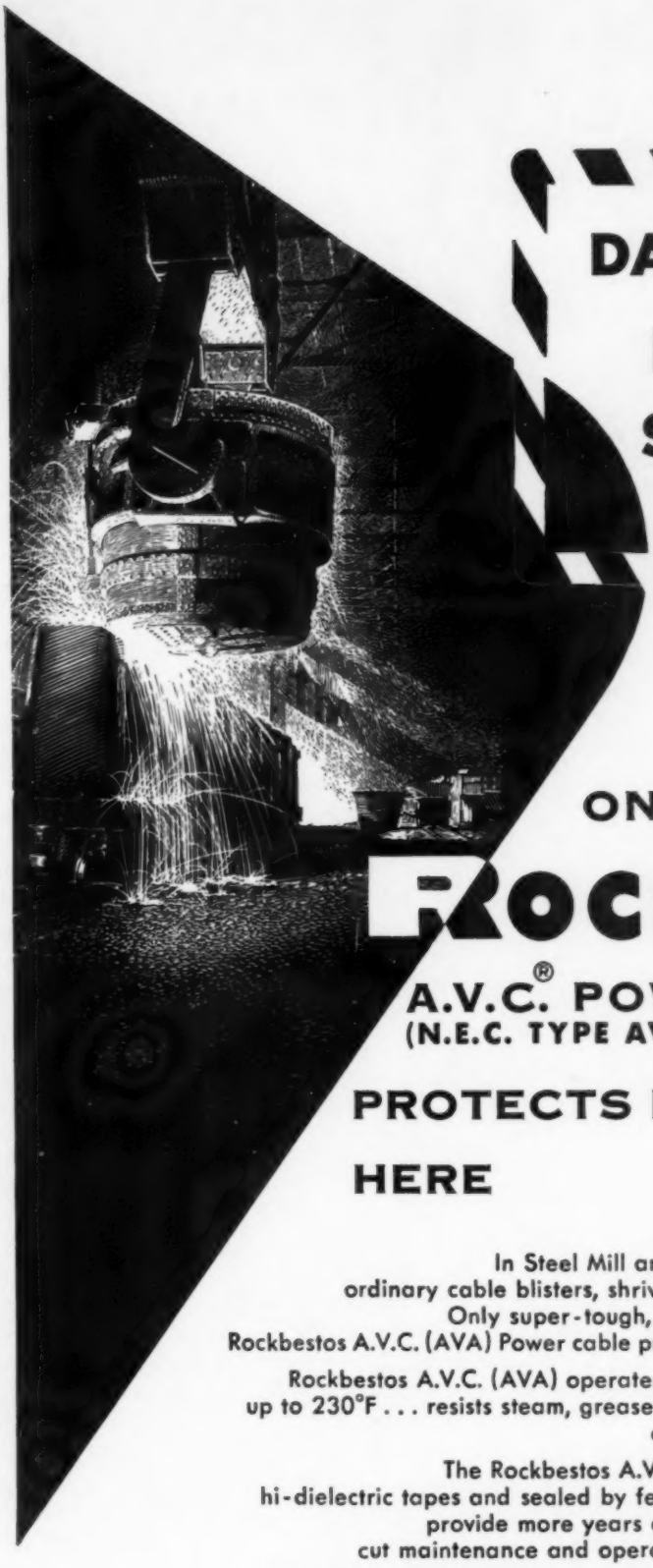
The tool steel manufacturer followed the advice of Electro-Alloys engineers, who recommended that the new retorts be centrifugally cast of ACI type HH alloy. Containing 24 to 28 per cent chromium and 11 to 14 per cent nickel, this type has high strength, ductility and corrosion resistance at temperatures up to 2000 F. The HH grade can be produced as partially ferritic or wholly austenitic; the ferritic providing highest hot ductility, and the austenitic highest hot strength. The particular composition chosen was an austenitic modification designed for high strength and maximum resistance to embrittlement.

Previous experience with carbon steel retorts — The processor formerly used 20-ft seamless carbon steel pipes. Average life expectancy for these pipes was 500 cycle hours, or about 16 passes through the furnace. Replacement was required every eight weeks, primarily because of scaling and flattening, or deformation. Severe scaling from the hot gas corrosion diminished the section of the retorts, with consequent loss of strength, greater tendency to breakage, and less uniform annealing.

Because of loss of symmetry, the retorts could not be fully loaded or stacked properly in the furnaces, which resulted in poor economy of operation. In addition, cast iron plugs, designed to seal the ends of the retorts, could no longer be fitted properly after distortion of the pipe. Fire brick and mud were used to seal the open ends of the distorted members — a troublesome and time-consuming job. This type of plugging also failed to provide the gas-tight seal necessary for uniform annealing.

Experience with cast high alloy retorts — Cast in type HH alloy, annealing retorts installed 3½ years ago have given excellent service, and are still in good condition. Since the alloy resists the high sulphur content of the furnace gases, there is little scaling,

(*Please turn to page 138*)



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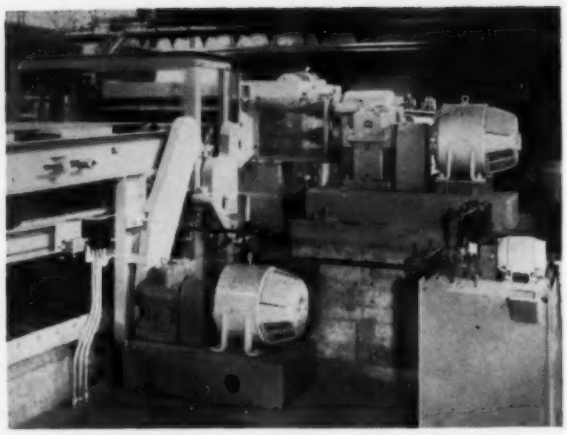
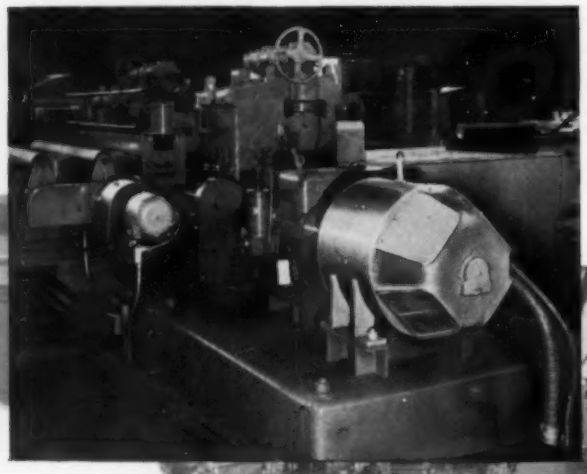
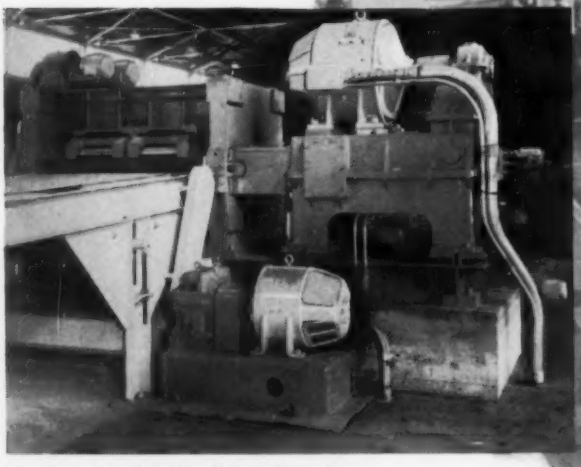


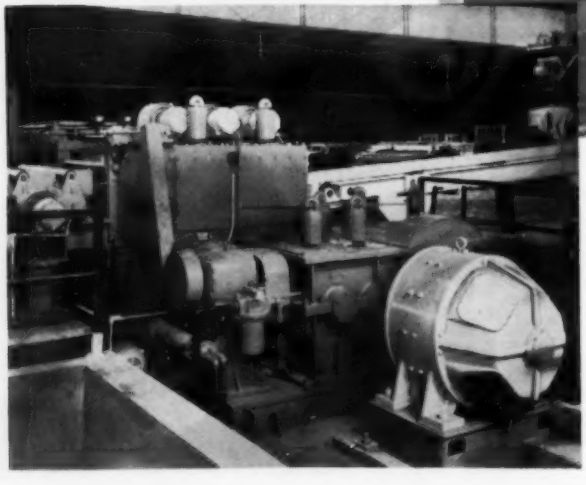
A 20-hp d-c motor, at right, drives the oil machine and pinch roll on the reject piler. Below, main drive for the belt conveyor, also a small a-c motor on an oil pump. All these are Elliott C-W motors.

The Elliott Crocker-Wheeler 40-hp, 850/1700-rpm d-c motor that drives the side trimmer in the shear line. At the left, an Elliott C-W 2-hp induction motor serving side guide adjustment.

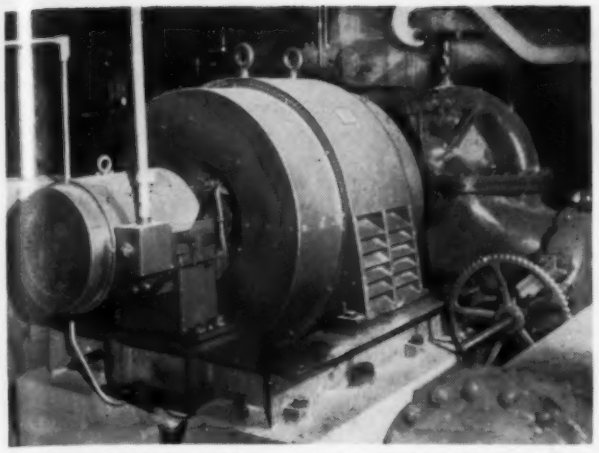




The leveller in the shear line is driven by the Elliott C-W 100-hp, 850/1500-rpm d-c motor shown at top. At bottom, a 15-hp motor drives the belt conveyor, and at top left, two 2-hp motors drive the roll adjustment.

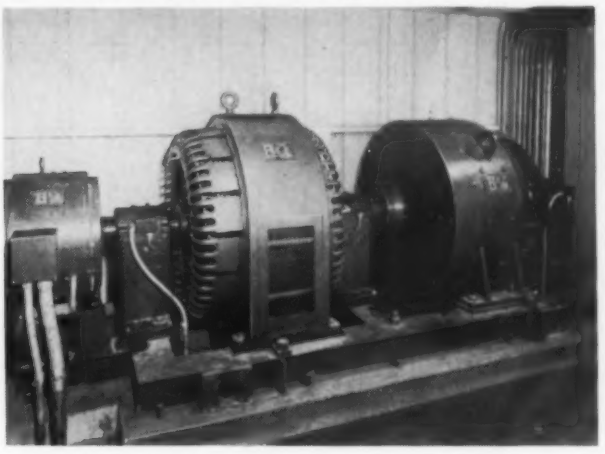


The Hallden shear and its main drive—an Elliott C-W 150-hp, 690/1200-rpm, dripproof, protected d-c motor. Also shown are three 2-hp and one 5-hp squirrel-cage motors on secondary drives.



An Elliott 1500-hp, 900-rpm, .8-pf, 6900-v dripproof synchronous motor with direct-connected exciter. This one drives one of the two large water pumps. Another pump is driven by an Elliott steam turbine.

Power for the shear line is supplied by this Elliott motor-generator, a 450-kw, 1200-rpm d-c generator with 25-kw exciter, driven by a 700-hp synchronous motor.



How ELLIOTT motors serve Pittsburgh Steel's expanded facilities

One of the major expansion projects of Pittsburgh Steel's Program of Progress is the new facilities in the Allenport Works, located 25 miles south of Pittsburgh. Among the important new installations in this mill are the hot shear line and a new water pumping plant. Elliott motors, ranging from 1 hp to 1500 hp, provide a number of main and secondary drives in both of these new additions. As the photos on these two pages indicate, a variety of Elliott motors are serving in this mill, as they are in others throughout the steel industry. Full details on the line are available at any Elliott District Office or from Elliott Company, Jeannette, Pa.

ELLIOTT Company

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Q3-4

Figure 2 — Type HH alloy annealing retorts (three on left) compared with carbon steel (two on right). In the latter, note the scaling, loss in section thickness, and lack of symmetry which prevents stacking, causes loss of loading capacity, and necessitates firebrick and mud seals.

(*Continued from page 134*)

and the retorts have retained their uniform wall thickness, insuring uniform annealing of the tool steel. No loss of symmetry has been detected. Reinforcing bands have not been necessary, and the furnaces can still be stacked to maximum capacity. Bayonet plug ends, also cast of the same alloy composition, remain gastight and easy to handle.

A high alloy wrought material was considered for this application, but a cast material rather than a comparable wrought grade was chosen since the cast alloy is stronger at the application temperature than comparable low carbon high alloy wrought grades, because of higher carbon content.

MUFFLE SECTIONS

Gas carburizing atmospheres combined with high temperatures pose a special challenge to materials of construction — a challenge being successfully met by the alloys of Group C, particularly by type HT which is useful in carburizing and carbonitriding atmospheres.

This is confirmed by engineers of Michiana Products Corp., Michigan City, Ind., who have developed high alloy muffle sections for long term reliable operation at temperatures up to 2000 F in modern mechanized furnaces. In high-volume gas carburizing, the muffles usually function in a temperature range of 1650-1800 F. Analysis of the gas is approximately 33 to 35 per cent H_2, 20 per cent CO, up to 7 per cent CH_4, and the balance is a carrier gas which is about 40 per cent nitrogen.

Prime requisite for the muffle section in the illustration was retention of strength at elevated temperatures, and resistance to both oxidizing and reducing conditions. Since sulphur corrosion was not a problem, one of the high nickel alloys could be used. Type HT, containing 33 to 37 per cent nickel and 13 to 17 per cent chromium (including up to 1.25 per cent silicon for increased resistance to carburization) was selected. This type operates satisfactorily at temperatures up to 2100 F in oxidizing atmospheres, and up to 2000 F in reducing atmospheres, provided that limiting creep stresses for any given temperature are not exceeded. As in all high nickel types, the alloy is fully austenitic and notable for excellent hot strength.

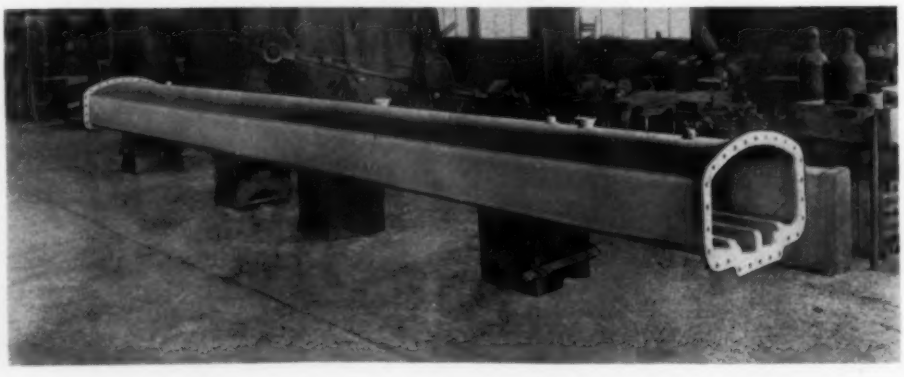
By choosing HT alloy for this application, the manufacturer maintained the necessary properties, enabling the user to reduce delays and costs. The long useful life of the muffle section permits the user to take full advantage of the large volume production of small parts provided by the gas carburizing process.

SUMMARY

According to metallurgists of the Alloy Casting Institute, the lessons learned from these case histories can be applied to many fields other than heat treating equipment. These conclusions can be briefly summarized; in strong oxidizing or reducing atmospheres with possibly high sulphur content, and where only moderate strength is required, alloys in Class A are generally satisfactory. Where high strength is required, as well as resistance to oxidizing, reducing, or sulphur bearing gases, alloys in Class B normally provide good service. Where even greater hot strength and reliability under cyclic temperature conditions is needed, Class C alloys are frequently chosen and will resist attack by nearly all furnace gases with low sulphur content.

To select the cast alloy within each class best qualified to answer a particular design problem, however, engineers need much specific information, and expert evaluation of the service conditions is advisable. It is wise, therefore, to consult a metallurgist at one of the foundries specializing in high alloys, to be assured that the completed casting will have the desired performance characteristics.

Figure 3 — One of a group of muffles for gas carburizing used by a large bearing manufacturer. Casting is type HT alloy.



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GRANITE CITY STARTS OPERATION OF NEW ROUGHING MILL

▲A new $16,000,000 four-high reversing roughing mill, most modern in the world, started operating at 2 a.m. September 4 at Granite City Steel Co., Granite City, Ill. The installation of this piece of machinery was one of the final steps in the steel company's current $68,000,000 expansion and modernization program.

The new mill will easily handle more than 1,200,000 ingot tons of steel a year—the full production of the company's open hearth furnaces—as compared to the former roughing mill's top capacity of about 700,000 tons a year.

Designed and constructed by United Engineering & Foundry Co., the new mill will handle slabs averaging 14,000 pounds in weight and produces steel strip 60 in. wide. The mill is fully automatic in operation.

The company's current expansion program, which started in February, 1951, will virtually double its annual capacity, from 622,000 ingot tons in 1952 to 1,200,000 ingot tons and will be completed this fall, although it will be some time before operations can be completely integrated and full benefits of the expansion program realized.

The program started with the company's purchase of the Missouri-Illinois Furnaces of Koppers Co., including two blast furnaces and 49 coke ovens. Since this purchase in early 1951, Granite City Steel Co. has installed three new 300-ton open hearth furnaces, a $22,000,000 blooming mill, three new slab furnaces and other new or modernized steel-making facilities, as well as adding 27 new coke ovens in the blast furnace department.

NEW ROUGHING MILL OPERATING DETAILS

The new roughing mill is part of the hot strip department. Slabs from the blooming mill are carried to the hot strip slab yard on specially constructed narrow gauge railroad cars which will carry about 50 tons of slabs each. The slabs can be stored temporarily in a modernized area adjacent to the new slab furnaces or can be fed from the cars directly into the slab furnaces for reheating. This feature saves a great deal of fuel and assists in maintaining a high rate of operation in the hot strip mill.

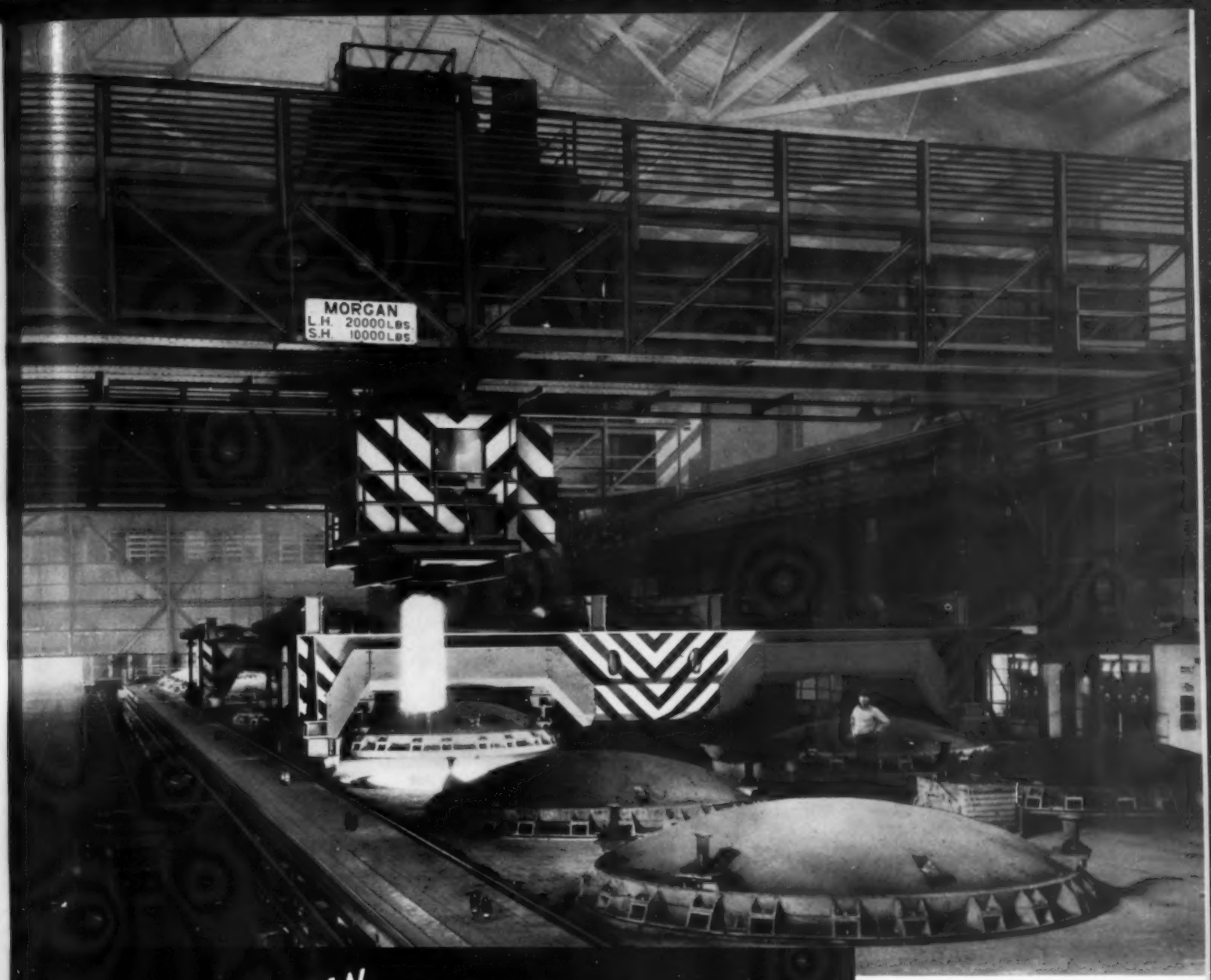
Reheated slabs then go into a rejuvenated scale-breaker which cracks and washes away scale and other impurities on the surface of the slab. From there, slabs pass to the new roughing mill.

This mill is backed up by a 47-ton flywheel motor generating set powering two 3,500-hp motors for the top and bottom work rolls of the mill and another 1,000-hp motor operating the edging mill. These main motors are rated at 7,000 hp.

Following reduction on the new mill, steel is cropped, and goes to finishing stands which have been modernized and on which power has been stepped up. The steel, now in strip form, is then passed over an X-ray gauge to measure thickness and then coiled. A new coiler and longer runout tables have also been added.

On the old setup, the mill averaged about 80 tons an hour and it is anticipated that this unit will average between 200 and 300 tons an hour.

In the past, about 60,000 tons a month were rolled. Now Granite City will be able to handle easily the full production of the open hearth plant of 100,000 tons of ingots a month.



BUILT BY MORGAN *Engineering*

MORGAN CRANES AT PUEBLO

Illustrated is one of two Morgan 10-ton, 7-motor, 94′5″ span Soaking Pit Cranes at The Colorado Fuel & Iron Corporation's Pueblo Works. These cranes have a tongs range of 15″-30″. All motions on trolley are through worm reduction units. The trolley frame, bridge trucks and ram are fabricated and welded into one-piece units.

Morgan has followed very closely the development of soaking pit cranes from the first tower and rack type to the present modern low stiff leg type built with or without counter-weights. Send for Bulletin 32-A.

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Gyralites when automatically controlled by a time switch, pressure switch, float switch or an electric eye, etc., make excellent alarms for safeguarding equipment and personnel in innumerable plant operations.

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TRUCK EFFICIENCY TEST TELLS WHEN CORRECTIVE MEASURES ARE NEEDED

By HAROLD MILZ
Chief Engineer
Mercury Manufacturing Co.
Chicago, Ill.

▲ Well-designed, properly-maintained electric-powered industrial trucks should operate at between 100 to 120 *watts* per *ton* per *mile* per *hour*.

If your trucks are consuming power at this rate, they are running efficiently. However, if more than 120 watts are required, they are consuming considerably more power than they should.

One way to determine the efficiency of your electric-powered handling equipment is to run an efficiency test.

The following industrial-truck efficiency test — requiring only a few test readings and a few simple calculations—will give the necessary facts. With this test one can evaluate the operation of both fork-lift and platform-lift trucks. The figures it provides will be useful in two ways: (1) they will tell you whether or not your trucks are performing economically; (2) they will help determine when trucks need minor adjustments or major overhauls.

In most cases, operating efficiencies can be restored with a few simple adjustments — slight deviations from satisfactory power consumption being the clue. However, when test figures indicate performance is far below par, major repairs may be required to eliminate serious damage to the electrical and mechanical components of the truck.

The equipment and facilities needed for this truck are as follows:

1. A 0 to 500-amp ammeter (with several shunts for lower scale readings).
2. A 0 to 100-volt voltmeter.
3. A stopwatch graduated to tenths of a second.
4. A platform scale large enough to weigh the truck and its load.
5. A smooth, level concrete floor approximately 200 ft long.

For ease of calculation and to provide a permanent record, test readings should be recorded on a data sheet similar to those shown in Figure 1. These sheets are used to rate the performance of new Mercury trucks before they are shipped, and for periodic check-ups of Mercury equipment in use. The form you use may or may not have to be this complete, depending upon the other records you keep on your equipment.

Facts that are absolutely essential to the test and that should be recorded on this sheet are:

1. Truck weights, both loaded and unloaded (drive-wheel loads, trail-wheel loads, and total loads).
2. Travel time required to traverse a measured course in forward and reverse directions, both light and loaded.
3. Time required for forks and telescopic mast to travel a measured distance, both light and loaded.
4. Left and right turning radii.
5. Forward and backward tilt angles.

Other facts that it is advisable to record are: date of test; number of test; test personnel; type of battery;

Figure 1 — Test sheet on left reveals inferior truck performance. Sheet on right illustrates typical test results when truck is operating economically and with no mechanical or electrical defects.

LIFT & FORK TRUCK TEST DATA

CUSTOMER ... ADDRESS ...
TYPE OF TRUCK ... MODEL Nº ...
SERIAL Nº ... LOAD ... LOAD MOMENT ARM ...
BATTERY ... OPEN CIRCUIT VOLTAGE ...
DRIVE MOTOR ... TYPE ... SERIAL Nº ...
HOIST MOTOR ... TYPE ... SERIAL Nº ...
DRIVE WHEEL TIRES ... TIRE SIZE ...
TRAIL WHEEL TIRES ... TIRE SIZE ...
CONTROLLER ... MODEL NUMBER ...
DATE OF TEST ... TESTED BY ...

TRAVEL PERFORMANCE LIGHT

DIRECTION OF TRAVEL	AMPS.	VOLTS	SEC.-60'	F.P.M.	M.P.H.
OPERATOR LEADING					
LOAD LEADING					
OPERATOR LEADING					
LOAD LEADING					

WATTS PER TON PER MILE PER HOUR =

TRAVEL PERFORMANCE LOADED

DIRECTION OF TRAVEL	AMPS.	VOLTS	SEC.-60'	F.P.M.	M.P.H.
OPERATOR LEADING					
LOAD LEADING					
OPERATOR LEADING					
LOAD LEADING					

WATTS PER TON PER MILE PER HOUR =

HOIST PERFORMANCE

	LIGHT MAIN	LIGHT TEL.	LOADED MAIN	LOADED TEL.
AMPS				
VOLTS				
TIME S				
DISTANCE				
F.P.M.				

LOWERING SPEED — LIGHT — LOADED

PRESSURE

WEIGHT LOADED — DRIVE — TRAIL — TOTAL
WEIGHT LIGHT — DRIVE — TRAIL — TOTAL

RIGHT TURNING RADIUS
LEFT TURNING RADIUS
TILT FORWARD ... DEGREES
TILT REVERSE ... DEGREES

OVERALL LENGTH ... OVERALL WIDTH ... COLLAPSED HEIGHT ...
WHEEL BASE ... PLATFORM SIZE ... FORK SIZE ...
MINIMUM ELEVATION ... MAXIMUM ELEVATION ... TEST: 1 2 3 4
REMARKS:

LIFT & FORK TRUCK TEST DATA

CUSTOMER ... ADDRESS ...
TYPE OF TRUCK ... MODEL Nº ...
SERIAL Nº ... LOAD ... LOAD MOMENT ARM ...
BATTERY ... OPEN CIRCUIT VOLTAGE ...
DRIVE MOTOR ... TYPE ... SERIAL Nº ...
HOIST MOTOR ... TYPE ... SERIAL Nº ...
DRIVE WHEEL TIRES ... TIRE SIZE ...
TRAIL WHEEL TIRES ... TIRE SIZE ...
CONTROLLER ... MODEL NUMBER ...
DATE OF TEST ... TESTED BY ...

TRAVEL PERFORMANCE LIGHT

DIRECTION OF TRAVEL	AMPS.	VOLTS	SEC.-60'	F.P.M.	M.P.H.
OPERATOR LEADING					
LOAD LEADING					
OPERATOR LEADING					
LOAD LEADING					

WATTS PER TON PER MILE PER HOUR =

TRAVEL PERFORMANCE LOADED

DIRECTION OF TRAVEL	AMPS.	VOLTS	SEC.-60'	F.P.M.	M.P.H.
OPERATOR LEADING					
LOAD LEADING					
OPERATOR LEADING					
LOAD LEADING					

WATTS PER TON PER MILE PER HOUR =

HOIST PERFORMANCE

	LIGHT MAIN	LIGHT TEL.	LOADED MAIN	LOADED TEL.
AMPS				
VOLTS				
TIME S				
DISTANCE				
F.P.M.				

LOWERING SPEED — LIGHT — LOADED

PRESSURE

WEIGHT LOADED — DRIVE — TRAIL — TOTAL
WEIGHT LIGHT — DRIVE — TRAIL — TOTAL

RIGHT TURNING RADIUS
LEFT TURNING RADIUS
TILT FORWARD ... DEGREES
TILT REVERSE ... DEGREES

OVERALL LENGTH ... OVERALL WIDTH ... COLLAPSED HEIGHT ...
WHEEL BASE ... PLATFORM SIZE ... FORK SIZE ...
MINIMUM ELEVATION ... MAXIMUM ELEVATION ... TEST: 1 2 3 4
REMARKS:

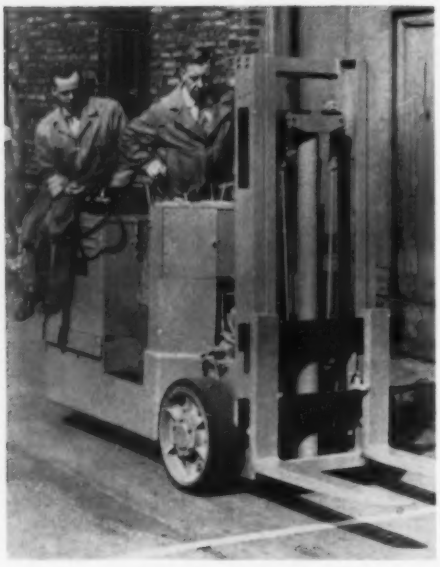


Figure 2 — The test is best run with two men. One drives the truck over the zero mark on a measured 88-ft test course, the other records stop-watch and current and voltage readings.

and corrective steps recommended and taken.

Although it is possible for one man to both operate the truck and take the necessary readings, the test can be run more easily and with greater accuracy when one man drives and one man records test data, see figure 2. Here is a step-by-step outline of how the test should be run:

1. Measure off an 88-ft length on the 200-ft stretch of concrete, make sure that you have at least 50-ft approach at each end.
2. Weigh truck without load.
3. Record drive-end weight, trail-end weight, and total weight values in the appropriate places on sheet, Figure 1.
4. Connect voltmeter across the battery terminals and put ammeter in series with the main line by connecting it between the battery and the controller.
5. Run truck in a forward direction (forks leading toward the test course).
6. Start stop-watch as the truck passes over the zero mark on the course.
7. Record ammeter and voltmeter readings in columns 1 and 2 of "travel performance light" table.
8. Stop watch as the truck passes over the 88-ft mark.
9. Bring truck to a stop near the end of the 200-ft distance.
10. Record the elapsed time for the 88-ft forward traverse in third column.
11. Start truck in a reverse pass across floor (forks trailing), repeat the timing and meter-reading procedures specified above and make the appropriate recordings.

When conducting the first test on any given course it is a good plan to turn the truck end for end and repeat the above procedure so as to make sure that the course is level. Even a slight grade will result in much better performance in one direction than in the other.

Now we are ready to start the hoist-speed measurements.

1. Measure off and mark with chalk two 2-ft vertical distances, one on the main and one on the telescopic member of the hoisting mast and chalk off one indicating mark at the middle of the vertical part of the fork assembly and another near the bottom of the telescopic mast, as shown in Figure 3.
2. Start the hoisting mechanism.
3. Start watch as a selected point on your fork assembly passes the zero chalk mark on the telescopic member.
4. Record the ammeter and voltmeter readings in the "hoist performance" table on the form.
5. Stop watch as the point passes 2-ft chalk mark.
6. Record the time for the fork assembly to traverse the 2-ft interval.
7. Repeat the above procedure recording the ammeter and voltmeter readings and the travel times involved in the elevation of the telescopic channel assembly through the measured 2-ft interval.
8. Next, pick a capacity load, weigh the truck with load and repeat all of the previous procedures, this time recording the data in the "truck loaded" columns.

When these readings are entered on the sheet, make right and left turning-radius measurements and forward and reverse tilt measurements. The usual procedure for turning-radius measurement is to successively steer the truck through clockwise and counter-clockwise circles with the minimum available turning radius (steering hard over) and drawing the turning circle on the floor by means of a chalk stylus positioned at the projecting rear corner. Measurement of this inscribed circle will give the turning radius in the direction operated. The test is now complete. Next come the calculations.

The 88-ft distance is used in this test to simplify calculations. It does so because 88 fpm (or 60 sec) equals 1 mph. In other words, if the 88-ft run is timed in 10 sec, the truck is

$$\text{traveling } \frac{60 \text{ sec}}{10} \text{ or 6 mphr.}$$

In this manner, the four travel-speed figures — one forward and one reverse with the truck light and one forward and reverse with the truck loaded — are obtained. Forward and reverse readings are taken to assure that the truck operates with equal ease in both directions, or to indicate defects such as brush mis-alignment.

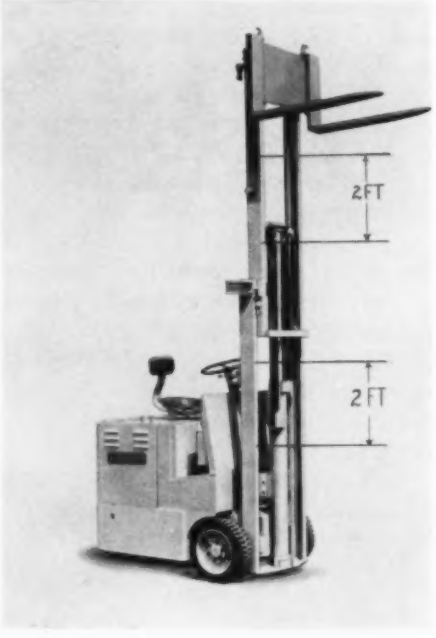
Because industrial-truck batteries that are in constant use are sometimes below their rated voltage levels, we must correct the "recorded" travel speed reading we have just calculated by multiplying it by *rated voltage* and dividing by actual *read voltage*. For example, if as we have determined, our measured travel speed is 6 mphr, the truck is powered with a 15-cell lead-acid battery of 30-volt rating, and our voltmeter reading during test is only 28 volts, we must calculate as follows:

$$6 \text{ mphr} \times \frac{30 \text{ volts}}{28 \text{ volts}} = 6.43 \text{ mphr}$$

We follow this procedure with all "recorded" values to get corrected (or true) mphr figures.

With this done, we are now ready to calculate the truck's power con-

Figure 3 — Two-foot distances on the main and telescopic masts permit hoist performance measurements to be made.



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MANNING, MAXWELL & MOORE, INC.

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sumption rate. To do this, we use the following formula: *Watts* per *ton* per *mile* per *hour* equals voltage times current divided by speed (in miles per hour) and truck weight (in tons), or:

$$\text{Watts/ton/mphr} = \frac{V \times A}{S \times W}$$

where V and A are voltage and current values, as read, and S and W are speed and weight. For example (from Figure 1):

Power consumption =

$$\frac{28 \times 65}{4.58 \times \frac{5390}{2000}} = \frac{1820}{4.58 \times 2.69}, \text{ or}$$

Power consumption =

147 Watts/ton/mphr

Next, we calculate hoisting speeds, in fpm, by inserting time and distance figures from the "hoist performance" table into the following formula:

$$\text{Hoisting speed} = \frac{2 \text{ ft} \times 60,}{\text{Time}}$$

The 2-ft figure being the chalk-marked distance on both the main and telescopic members of the hoisting mechanism, the time being in seconds (as recorded), and "60" being the conversion factor. From our data, the hoisting speed in the first stage (in the telescopic channels) and without a load is calculated to be:

$$\text{Hoisting speed (Main)} = \frac{2 \text{ ft}}{3.6 \text{ sec}} \times \frac{60 \text{ sec}}{1 \text{ min}}, \text{ or}$$

Hoisting speed (Main) = 33.3 fpm

Other hoisting-speed values — for the loaded first stage and for loaded and unloaded second stage (in the main channels) — are calculated in the same manner. This finishes our calculations.

We are now ready to turn these test figures and calculations into useful tools that will both tell us how well our equipment is performing and indicate which parts need adjustment, repair or replacement. We do this by analyzing and comparing operating characteristics with rated characteristics. The procedure we should use is as follows:

Look for deviations from normal. If there are none and your power-consumption rate is between 100 to 120 watts per ton per mphr, your truck is in top operating condition. If there are none and the work output of your truck is far below expected levels — for example, if the truck gets only five hours of operation on a charge, rather than eight — then either of two conditions must exist: (a) work conditions must have changed, or (b) the battery must be at fault. If it is the latter, the battery deterioration may be excessive.

If there are deviations from normal in your travel performance figures, one of three conditions probably exists. Here is what to look for:

Condition 1: If current values are up and traveling-speed values are down, the truck is either operating with excessive mechanical friction or faulty tires. Excessive mechanical friction might be caused by dragging brakes, a jammed or tight oil seal, a broken or frozen bearing, lack of lubrication, or mis-alignment in either the steering or driving mechanism. A faulty tire condition might mean a flat spot on the tread, a loose tread (because of faulty tire compound), or a cut tire.

Condition 2: If both current values and traveling-speed values are up, there is definitely trouble in the motor — for instance, weak fields caused by one field being fully or partially shorted out.

Condition 3: If current values are normal and traveling-speed values are low, there is a loss of voltage between the battery and the motor. This voltage loss can be caused by either loose bolts at battery terminals, poor connections between lugs and wire, poor contact at controller tips, poor contact between commutator and brushes, or loose connections inside the motor.

In a high-lift system, if hoist performance is below normal, then either of three conditions exist: (a) fluid liquid flow is impeded or restricted, (b) the fluid is by-passing and not doing its assigned work, or (c) mechanical friction is responsible. If a fluid flow restriction is present in the pressure line, such as a kinked copper tube, current values will be up and hoist-speed values down. A restriction in the intake or suction line can usually be detected by excessive pump noise. When the fluid is by-passing, pressure will be low. The truck will lift its full rated load at reduced speed, or it may not lift it at all. Look for hoist cylinder packing leakage, low relief-valve setting, or an external leak. Mechanical friction will cause current values to be high and hoist speeds to be low. High current values coupled with excessive hoist speed indicate motor trouble.

With this background knowledge, let us now evaluate the operating performances of the trucks whose tests sheets are shown in Figure 1. Our first indication that something is physically wrong with the truck whose test sheet is shown on left of Figure 1, is the high power consumption figure, particularly in the "travel performance light" table. This 147 watts per ton per mphr figure tells us that not only is the truck wasting over 20 watts of power, but that unless some corrective measures are quickly taken, serious and costly damage will result. Other records (not shown) showed that this truck's performance had not been checked in six years and that during this time it had been subjected to continuous abusive use.

Let us investigate further. As explained in Condition 1, the high current and low traveling speed values of 65 amp and 4.58 mphr indicate that the truck is operating with either excessive mechanical friction or faulty tires. Closer inspection of the truck, now that we know what we are looking for, reveals that the truck's brakes are dragging. When corrected, performance figures were slightly better than manufacturers test figures. (Tests after substantial use reveal improved operation because gears, brushes and all moving parts become properly seated and broken in.)

Next, let's look at this truck's hoist-performance figures. Comparison with the manufacturers performance test, made when the truck was new, reveals that the first-stage hoist performance figures, both light and loaded, are unchanged. However, the performance figures of the second stage of hoisting show considerable deviations. Instead of approximately 130 amp, 4.6 sec and 26 fpm, in the loaded condition we have now 180 amp, 6.1 sec and 19.6 fpm. Investigation showed that this poor performance was caused by a defective roller bearing in the second stage of the lift mast.

The difference in turning-radius figures was found to be caused by a bent steering arm. When the arm was straightened, equal turning radii were restored. The forward and reverse tilt degree figures (3 and 10 degrees), indicate no malfunction in the tilt mechanism.

In contrast to this, the test figures for truck on right of Figure 1 indicate economical, low-cost fork truck operation and no mechanical defects.

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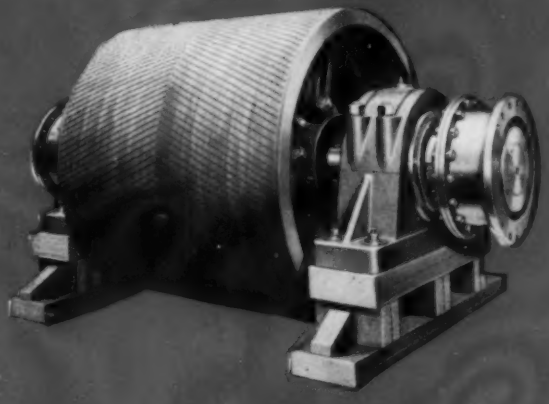
- Tailor-made to meet your requirements in standardized designs for belt tensions up to 1500 pounds per inch of face.
- Mounted on shafts with Jones-Timken pillow blocks and couplings factory assembled to simplify field erection.
- Drive Pulleys with plain or grooved lagging.

End view of Jones 60" x 64" Pulley showing heavily ribbed arms and split-clamp hub.



Jones 60" x 57" Rubber Covered Pulley mounted on 9" Jones-Timken Pillow Blocks

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Westinghouse engineers sensed and actually measured these wearing forces in order to build rugged dependability into d-c mill motors and matched controls. You can see the results in the specially constructed armature of the Westinghouse series 600, d-c mill motor. Its low inertia allows the motor to start—stop—and reverse the heaviest load in a split second, providing high-rated efficiency . . . maximum performance.

Examine the Westinghouse Type M Contactor, too. Located at the heart of many mill drives, it withstands millions of make-and-break actions. To reduce wear, a friction-free, knife-edge bearing supports the contactor armature . . . "quick-quench" arc box protects contact life. For rapid cyclic drive operations, a strong kickout spring gives fast action in opening contacts.

In constructing tougher d-c motors, Westinghouse uses a heavy-duty steel motor frame and brackets. For sounder insulation, field coils are individually assembled and wrapped. Placed around a steel shell and insulated, they form a solid mass protected from chafing or grounding. Cast-brass, interchangeable, brushholder adds long life, too.

Investigate Westinghouse mill motors and controls. Ask your local Westinghouse salesman for booklet B-5650; or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

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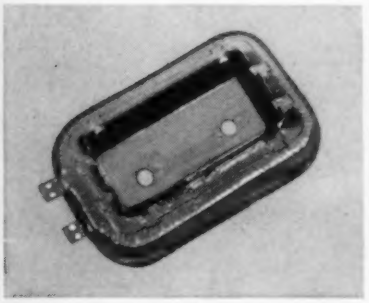
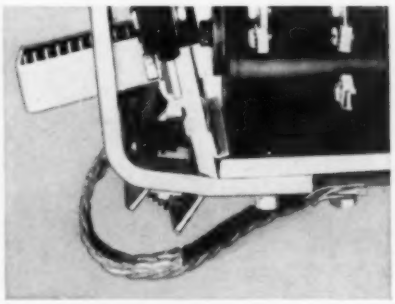
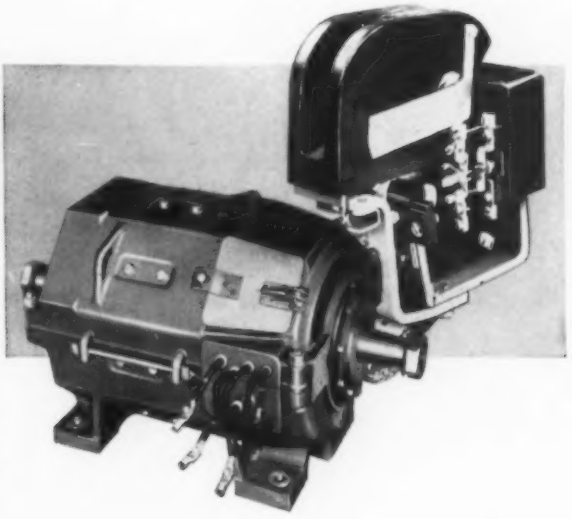


Solid field coil construction resists mechanical or electrical shock. A steel washer, placed on top of the coil and tack welded to lips of the inner steel shell, holds coil and shell in a rigid assembly. Coil unit is then vacuum impregnated in Thermoset varnish.



Knife-Edge Bearing—Type M Contactor armature operates on a fulcrum of specially hardened steel. There are no hinge pins to wear—corrode or cause trouble by jamming. Dust will not collect at this point as it is worked out of the bearing by pincer action.



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The safety pin was a simple invention — yet, as any new mother will testify, it has no substitute.

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This new tube is the latest development of the inventor of the radiant tube furnace. The "O" design brings the furnace to heat faster than ever before possible, and allows tube placement that delivers unmatched uniformity and permits pin-point control of annealing.

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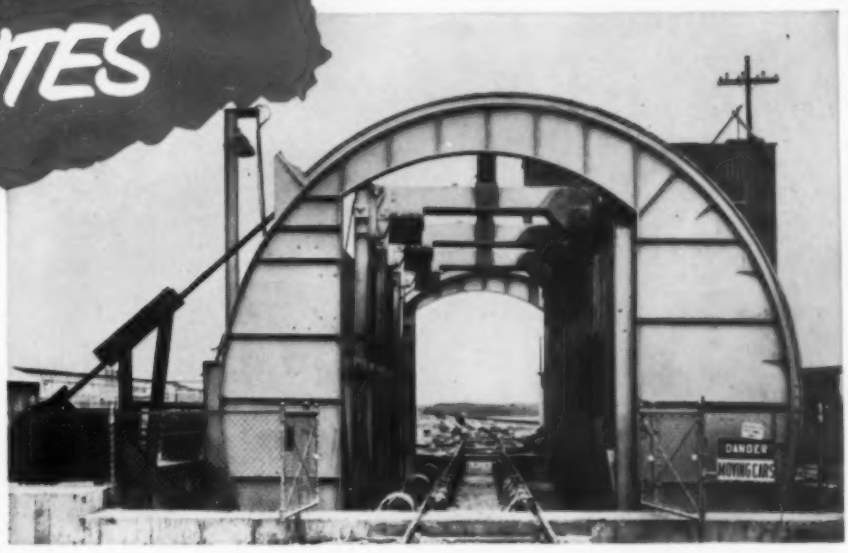
All in a matter of

2 MINUTES

Another 90 tons of coal unloaded by the *Heyl & Patterson* Rotary Car Dumper ...at Fairless Works



At the Fairless Works of the United States Steel Corporation, all rail shipments of coal, ore and limestone head directly for the new Heyl & Patterson 30 cars-per-hour Rotary Car Dumper. Here a 90-ton capacity railroad car is pushed onto the dumper, overturned to unload the contents, returned to an upright position and pushed off the dumper . . . all in a matter of two minutes.

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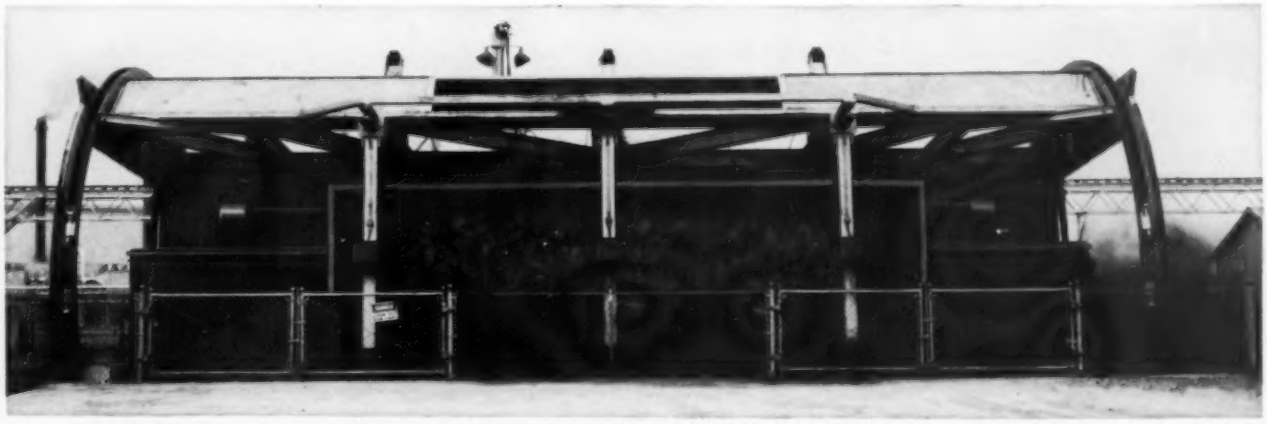

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Baldwin SR-4 devices have *uses unlimited* in industry . . . measuring load, pressure or torque economically, speedily and accurately. For the latest technical information please write to Dept. 3111, Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.

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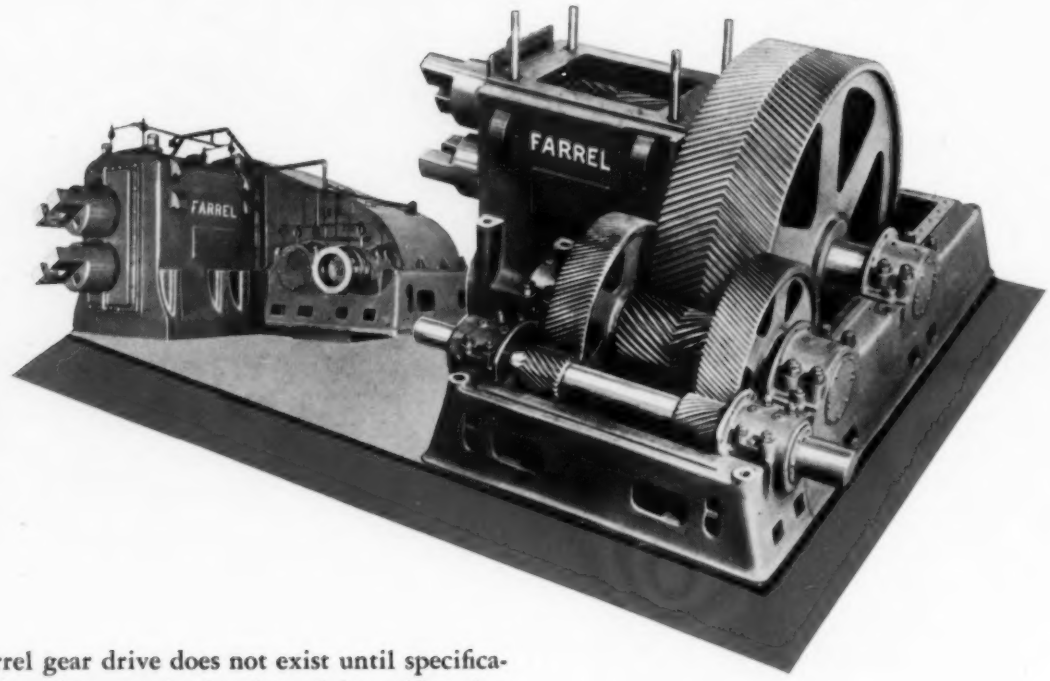
Your SPECIFICATIONS
design a Farrel drive



A Farrel gear drive does not exist until specifications have been received and careful consideration given individual requirements.

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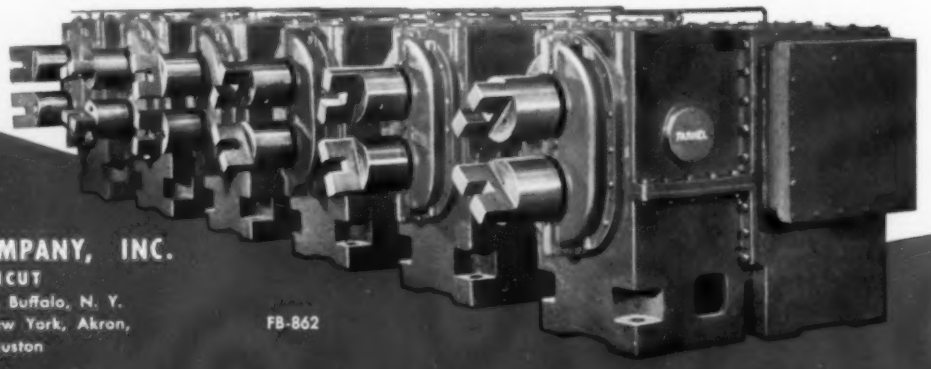
Above are two views of a combination reduction unit and pinion stand, transmitting 1250 HP. to a 26-inch two-high mill. The first reduction consists of split (divided) double helical gears. The second reduction gears and mill pinions are Farrel-Sykes continuous-tooth herringbone type, a compact gear arrangement which distributes the load uniformly and requires minimum floor space.

Below is a combination of drive and pinion stands for the first six mills of a ten stand rod tandem. The mills are driven by a motor connected to a herringbone gear reduction unit. Power is transmitted to the pinion stands through bevel gears mounted on a line shaft. Each succeeding pinion stand operates at a higher speed to accommodate the elongation of the rod as it changes form in passing through the mills.

Farrel engineers will be glad to discuss *your* gear drive problems with you at any time.



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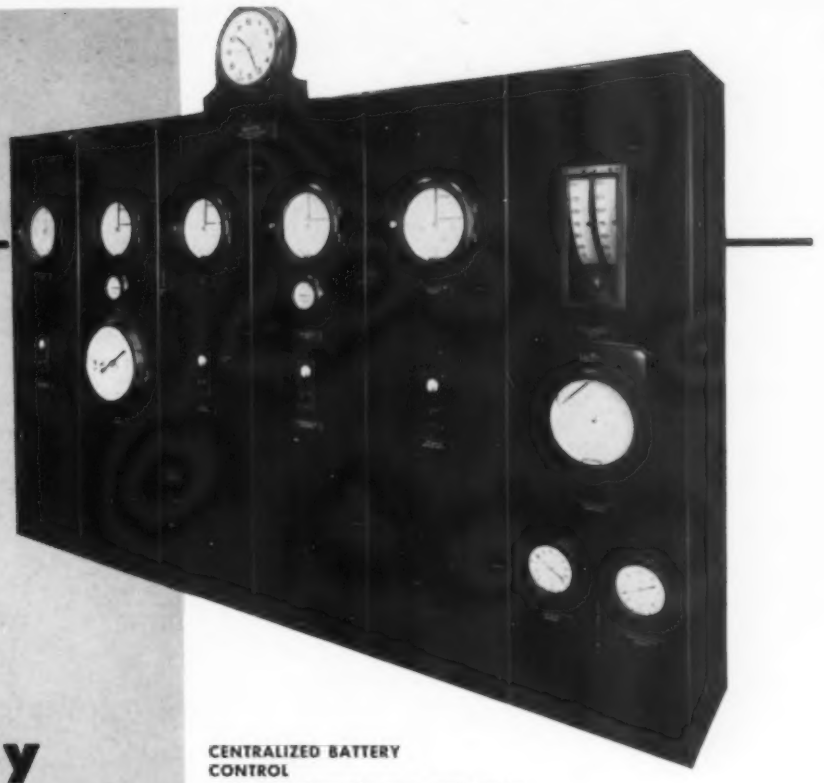

CENTRALIZED BATTERY CONTROL
at this panel permits an operator to coordinate automatic regulators controlling stack draft, fuel gas volume and pressure and blast furnace gas pressure. Gages and regulators monitor the system.

When a new coke battery was added to the coke plant of a mid-western steel mill, Republic electrically controlled hydraulic regulators were installed to control the additional capacity. These new type regulators supplement Republic-Smoot regulators which have been in operation on some of the older batteries for more than 34 years. Dependability, the determining factor in the selection of the new equipment, was more than proven by the performance of the older controls.

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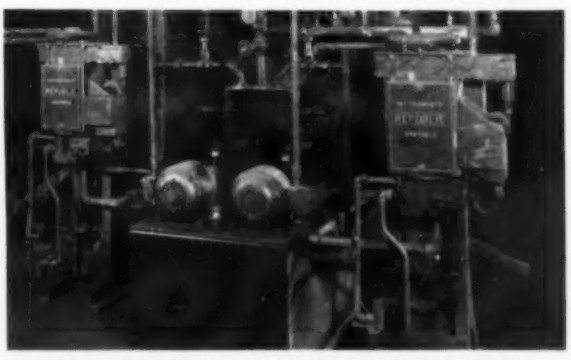
Write for literature on any of the above



ELECTRICALLY CONTROLLED REGULATORS. The control point of these Republic hydraulic type regulators is set electrically from control panel. In case of failure of hydraulic system, oil trapping valve will lock the regulators in their last position before failure. Electrical failure or accidental shorting of the transmission lines will not cause regulators to shift their control setting.

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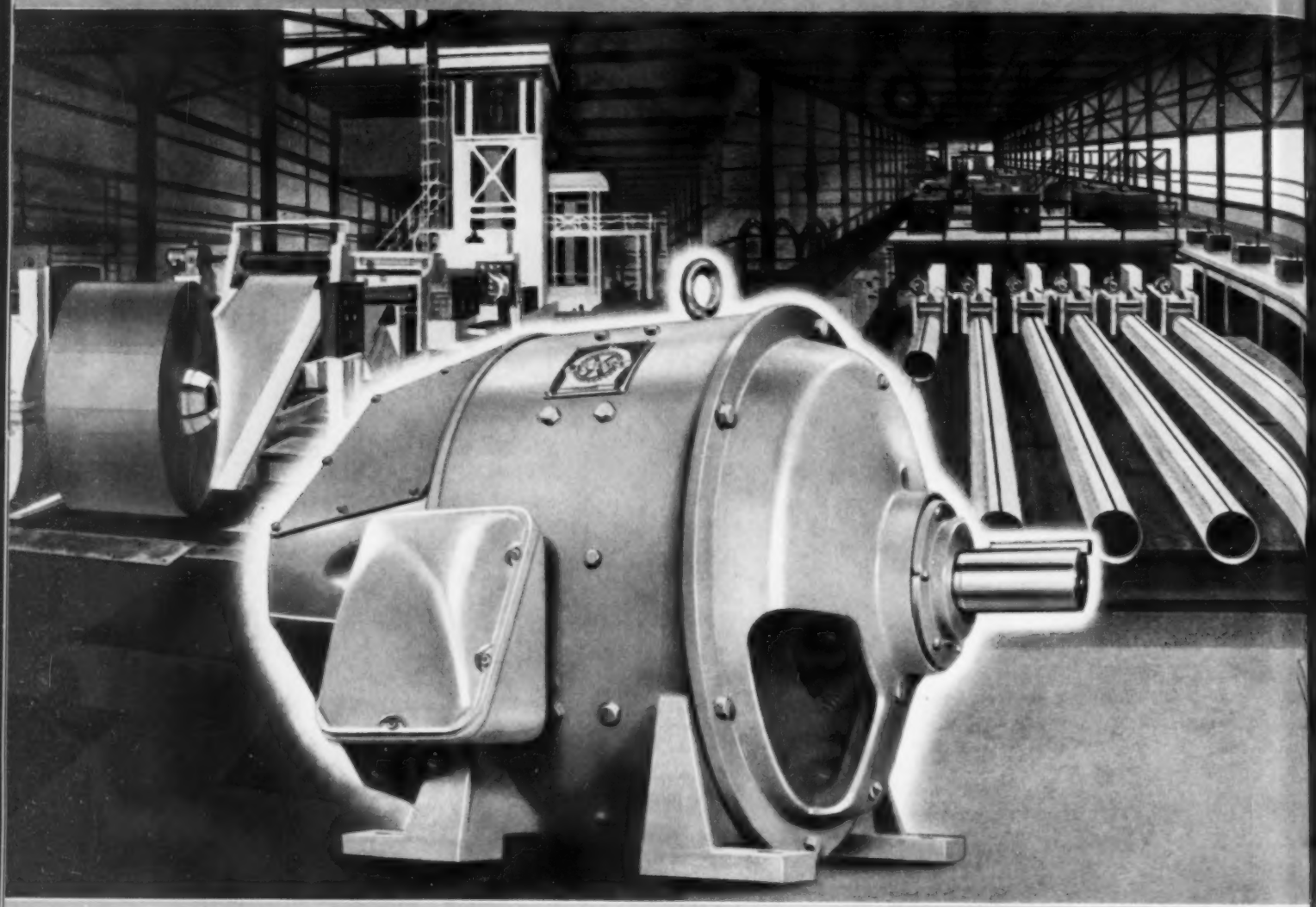

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Reliance adjustable-speed drive motors are engineered to respond instantly and accurately to the signals of associated controls and regulators in any motor-drive system. Co-ordinating mechanical design, horsepower and speed range of the motor with other components in a drive is the specialized job of Reliance Application Engineers. Their application experience and practical production knowledge give you whatever operating flexibility is required to produce more goods at less cost.

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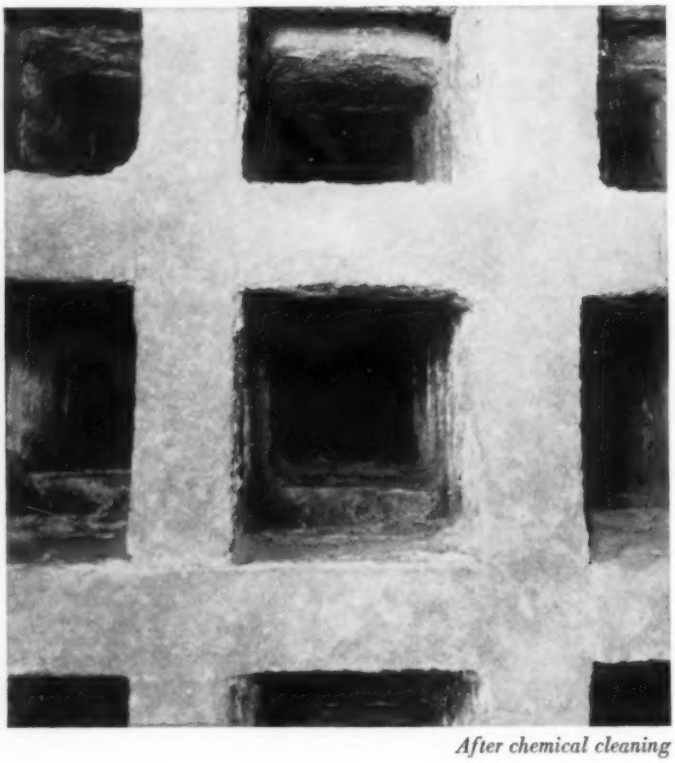

After chemical cleaning

Recently, Dowell was called to clean four badly fouled checkerwork chambers of an open hearth furnace. A high-pressure solvent jet, designed by Dowell to combine chemical and hydraulic action, made it possible to complete the job in only 10½ hours!

Inspection after cleaning showed the checkerworks to be free of deposits. This cleaning by Dowell Service avoided an expensive rebricking of the checker chambers which would have required a maintenance shut-down of four or five weeks.

This was the fourth time these checkerwork chambers had been cleaned by Dowell—and the fourth time that the operator had been well pleased with the results.

The high-pressure jet is used by Dowell engineers to spray the lateral openings between the bricks, in effect actually scrubbing the refractory surfaces with chemical solvents. The size and shape of the checkerworks seem to have no bearing on the effectiveness of the jet.

Dowell engineers have had extensive experience in cleaning industrial equipment with chemical solvents. Almost every piece of equipment found in blast furnace gas cycles and open hearth furnaces has been cleaned by Dowell. As a matter of fact, some have been cleaned while in actual operation.

Call a Dowell engineer to discuss your maintenance cleaning problems. He'll be glad to make a cost estimate on cleaning your equipment with chemicals. If you prefer, write directly to Tulsa, Dept. J-29.

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Date-line Diary...

September 2

▲ According to the Agriculture department farm exports fell 31 per cent below the previous year to $2,800,000,000.

▲ A wildcat strike started at the coke ovens in the Lackawanna plant of Bethlehem Steel Co.

▲ The Tennessee Coal & Iron Division of U. S. Steel Corp. was granted a tax write-off on 40 per cent of the $8,500,000 cost of an electrolytic tin plant to be built at Fairfield, Ala.

September 3

▲ The intensive diamond drilling undertaken by U. S. Steel Corp. at Norfolk County, south of Simcoe, Ontario has proved unsuccessful. Deposits were not of sufficient high grade to warrant deep mining operations.

▲ Edison Electric Institute reported utilities distributed 8,539,557,000 kwhr in the week of August 29, a new high.

▲ Personal income in July rose to $288,000,000,000 or $1,500,000,000 over June according to the Commerce department.

September 4

▲ As reported by the Bureau of Labor Statistics, hiring of new factory workers for July was at the lowest rate since 1949 and the sharpest drop since 1945.

▲ After a series of test iron ore shipments over the past few weeks, Steep Rock Iron Mines, Ltd. officially put into operation a second open-pit, the Hogarth Mine, at Steep Rock in Northwestern Ontario. This new open-pit mine is designed to produce 2,000,000 to 2,500,000 tons high-grade iron ore annually.

▲ The Commerce department reported employment in August rose to a new high of 63,408,000. Unemployed fell to a low of 1,240,000.

▲ John L. Collyer, president of B. F. Goodrich Co., predicted U. S. industry rubber consumption will reach a new high of 1,375,000 tons this year or 9 per cent above 1952.

September 5

▲ The first plant of the denationalized British steel industry sold back to private owners went to Templeborough Rolling Mills, British Ropes, Ltd., and William Cooke & Co., the original owners, for $20.30 a share.

September 8

▲ Contract battles are expected to begin early next month when railroad machinists and boilermakers demand wage increases. Engineers, conductors, trainmen and firemen will seek increases ranging up to 37½¢ an hr.

▲ U. S. Steel Corp. announced mill price bases for electrolytic and hot dipped tin plate, black plate and terne plate will be unchanged for period of October 1, 1953 through March 31, 1954.

▲ The AISI reports that operating rate of the steel industry for the coming week is scheduled at 88.7 per cent of capacity. This is equivalent to 2,000,000 tons compared with 2,040,000 one week ago.

September 9

▲ Carpenters rejoined the American Federation of Labor after a 28-day break-off with nothing gained except to strengthen A.F.L. president George Meany's position.

▲ The Agriculture department estimated cotton production at 15,159,000 bales this year, third largest production in history.

September 10

▲ First class railroads had a net income of $71,000,000 in July, 82 per cent over July 1952 when the steel strike slowed freight traffic.

▲ ARCI reports deliveries of new domestic freight cars in August totaled 5557 compared with 6370 in July, and 4537 in August 1952. Orders totaled 3913 leaving a backlog of cars as of September 1 of 45,735.

September 11

▲ Stocks held by manufacturing, wholesale and retail firms gained $600,000,000 during July as compared with an average monthly build-up of $700,000,000 during the second quarter.

▲ Durkin resigned as Secretary of Labor.

▲ Nickel decontrol will be postponed beyond October 1, according to the Government. This is due to a need for additional data on effects of nickel decontrol on the defense program and civilian economy.

September 14

▲ SEC reports that American business will invest a record $27,800,000,000 in new plants and equipment this year.

▲ B. I. England, president of the Atlantic City Electric Co., predicts electric utility industry in U. S. will more than double its generating capacity in a decade.

▲ The Lake Carriers Association announced a total haul of 15,236,527 gross tons iron ore in August, the first time in history of lake shipping that ore shipments exceeded 15,000,000 tons in a single month.

▲ The AISI reports that operating rate of the steel industry for the coming week is scheduled at 90.3 per cent of capacity. This is equivalent to 2,036,000 tons compared with 2,011,000 tons one week ago.

▲ Pig iron price was cut $2 by Alan Wood Steel Co. New prices are: basic, $58; foundry, $58.50; malleable, $59; and bessemer, $59.50.

September 15

▲ Steel scrap prices have declined again in the Pittsburgh district with further declines expected. The chief steel-making grade sold in small amounts at $41 a ton, off $1.

▲ According to Bolivia's Economic Minister, Bolivia will sign a contract to supply the U. S. 10,000 tons of tin for the next year at the market price.

September 17

▲ Reversing the upward trend in cost of lead since April, price dropped ½¢ to 13½¢ a lb in New York.

▲ Granite City Steel Co. made known that August was their best month ever with profits at $2,730,527. Their August shipments also totaled a record 90,000 tons of finished products.

▲ Alcoa began a $3,680,000 expansion program for ingot making facilities in Cleveland. This firm is also constructing a multi-million dollar press plant for the Air Force and expects to operate 30,000 and 50,000 presses for the military when completed.

▲ Ford Motor Co., Dearborn, Mich. has shut down their blooming mill for 15 days for mechanical improvements, also taking out of operation two open hearth and five electric furnaces.

▲ The Office of Defense Mobilization moved to expand the goal for electrolytic tin plate facilities from 4,100,000 to 4,500,000 net tons capacity annually. This is a 60 per cent increase over annual capacity of 2,800,000 net tons on January 1, 1950.

September 18

▲ Construction for August on 94,000 non-farm homes was 2000 less than in July.

▲ The Engineering News Record stated heavy construction contracts for the 4-day week ending September 17 came to $181,000,000. This brought a total of $11,100,000,000 for the first 38 weeks of 1953, off 7 per cent from the same period in 1952.

September 20

▲ The F. W. Dodge Corp. announced construction contract awards for August in the 37 eastern states at $1,414,408,000 which is 21 per cent under July's top record. Total for first eight months of 1953 is $11,115,588,000.

September 21

▲ Bethlehem Steel Co. plant at Lackawanna resumed operations following a back-to-work order from David J. McDonald, president of the CIO United Steelworkers Union. The strike idled more than 15,000 workers. McDonald called the strike a violation of the union's contract.

▲ The AISI reports that operating rate of the steel industry for the coming week is scheduled at 94.1 per cent of capacity. This is equivalent to 2,120,000 tons compared with 2,060,000 tons one week ago.

September 22

▲ Benjamin F. Fairless, chairman of U. S. Steel Corp., predicted steel operations will average about 95 per cent of capacity for the remainder of 1953.

▲ The Brotherhood of Railroad Trainmen group will demand a 37½¢ hourly wage increase when their present contracts expire.

▲ The Aluminum Association made known that total aluminum production for July amounted to 218,570,626 lb as compared with 156,735,591 lb in July 1952.

September 23

▲ The Commerce department reported public and private debt had increased 6 per cent in 1952, and the 1953 increase may equal or even surpass this rate.

September 24

▲ Machine tool maker's orders totaled $85,000,000 in August. This was a $12,000,000 increase over July but $6,700,000 less than August 1952.

September 25

▲ The Labor department reported factory employment in August showed the smallest gain over July since 1945.

▲ A further reduction in operations at its Canton and Massillon, Ohio plants was announced by Republic Steel Corp. The rate is being cut to 66 per cent of capacity and slightly more than 1000 employees have been laid off.

▲ The AISC reported August bookings of fabricated structural steel were 243,525 tons, 10 per cent above July; and shipments were 250,507 tons, 9 per cent above July. Backlog of work ahead as of August 31 stands at 2,121,665 tons.

▲ Government held farm products under price support programs totaled $3,400,000,000 on June 30, a $227,000,000 hike during the month.

▲ The Colorado Fuel & Iron Corp. earned $8,031,224 for the year ended June 30, 1953, 39 per cent above the preceding year's total of $5,761,965. Net income was equivalent to $3.09 per share of common stock.

September 28

▲ The AISI reports that operating rate of the steel industry for the coming week is scheduled at 94.9 per cent of capacity. This is equivalent to 2,139,000 tons compared with 2,144,000 tons one week ago.

▲ The Treasury department does not expect to seek a boost in their present $275,000,000,000 debt limit in 1953.

September 29

▲ Steel scrap prices in Youngstown have dropped sharply with No. 2 heavy melting scrap and No. 2 bundles selling at $28 and $26, down $5 to $6, and No. 1 heavy melting scrap being offered at $35, off $2 a ton.

▲ The CIO called its wage policy group to meet in New York on October 21, 8 months in advance of expiration date of its present contract, to discuss new proposals and perhaps the guaranteed wage.

September 30

▲ Unloadings of iron ore to this date have surpassed any comparable period in its history, according to K. C. Stevens, president of Pittsburgh & Conneaut Dock Co., subsidiary of U. S. Steel Corp. A total of 10,313,000 gross tons have been unloaded at their Conneaut docks during the season.

▲ Jones & Laughlin Steel Corp. has laid off 350 tin mill employees at their Aliquippa works, and U. S. Steel notified 500 tin mill workers they would be let out next month.

▲ Stockholders of Harrisburg Steel Corp. voted to split common and class "B" stock on a two-for-one basis. Authorized indebtedness was increased from $2,000,000 to $5,000,000.

▲ Tennessee Coal & Iron Division of U. S. Steel Corp. expects to increase production at its Fairfield, Ala. tin mill by 160,000 tons per year. A certificate of necessity for $8,500,000 was received to carry out the expansion.

▲ President Eisenhower and Secretary of the Treasury Humphrey dropped plans for a retail sales tax. They did not rule out the possibility of a general sales tax at the manufacturers' level.

▲ Bell System increased long distance telephone rates 8 per cent.

▲ Locomotive engineers asked the railroads for wage increases of $4 to $5 for an 8-hr day.

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2 You won't find E-M coil-ends in any contortion
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And tied to big bracing rings one after another.
You can be sure this E-M coil-end bracing
Is equal to any demand it'll be facing.

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In designing leak-proof bearings that always run cool.
Shaft journals are oscillation-honed so much clearer
Their super finish reflects your face like a mirror.
And the bearing sleeves are centrifugally cast
With strong bond and dense babbitt that last and last.

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Will come from E-M's pressure lubrication.
Take special notice of this choice you are given—
Oil pump can be direct or separately driven.
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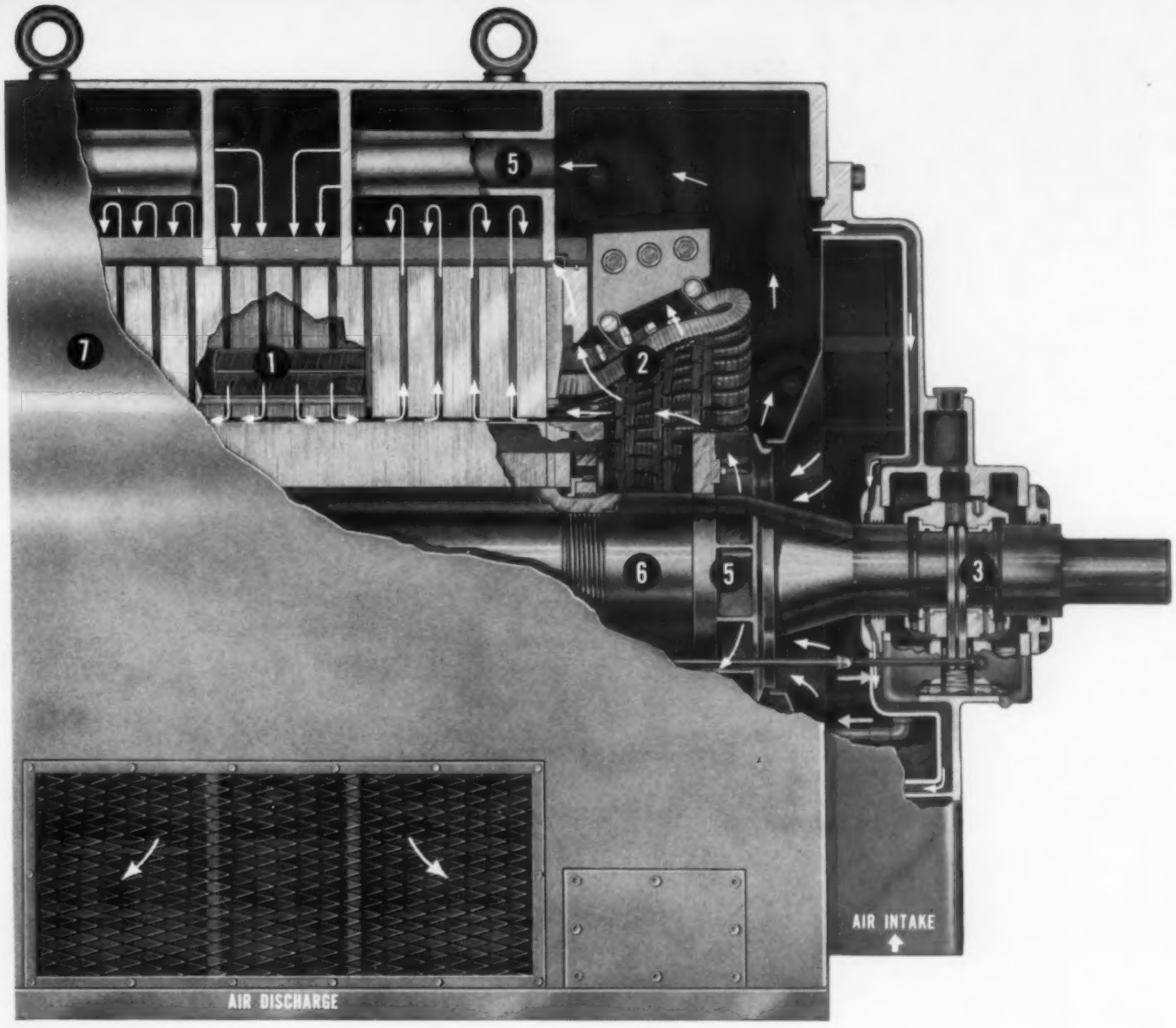

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Industry News...

NEW $30 MILLION SEAMLESS TUBE MILL OPENED BY COLORADO FUEL AND IRON AT PUEBLO PLANT

▲ Colorado Fuel and Iron Corp. officially opened its new $30 million seamless tube mill at Pueblo, Colo. The new mill, the first west of the Mississippi, will be an important supplier of seamless steel tubing and casing to the oil and gas industries of the western United States and Canada, according to Charles Allen, Jr., chairman of the board of directors of CF&I.

"The completion on schedule of this large plant marks an important forward step in the industrial growth of the West. Seamless pipe produced here will be readily accessible to the great oil and gas fields of Oklahoma, Kansas, Wyoming, west Texas, the Pacific coast, and western Canada," Mr. Allen said.

The ultra-modern new industrial structure covers more than ten acres under one roof, including billet yard and pipe storage. A. F. Franz, president of CF&I, stated that when full production is reached the mill will turn out over 150,000 net tons of seamless pipe a year.

The most modern equipment and techniques are used in the manufacture of the seamless casing and tubing, which ranges in size from two and three-eighths to nine and five-eighths in. outside diameter, Mr. Franz said. The first step in making seamless pipe is to pierce heated round steel billets to form a tube. Two piercing mills weighing 304 tons each with 3,000 hp motors perform this task. Then a 275-ton rolling mill, powered by a 1,500 hp motor, processes the rough tubes—lengthening the tubes and making their walls thinner. Next, expanding mills straighten the tubes, smoothing them inside and out. Finally a sizing or reducing mill finishes the products for the oil country goods market to meet the exacting specifications of the petroleum industry. Ten overhead cranes, having a capacity of from 10 to 20 tons each, will play an important part in the new mill's production setup.

A giant 70-ft rotary furnace, one of the largest ever constructed for American industry, has been installed in the new mill. Carefully controlled, uniform heating of steel billets is vital to the production of quality seamless tube and pipe; this new revolving-hearth furnace is designed to give a maximum degree of accuracy and uniformity in the heating process.

Billets of steel, some of them weighing as much as 2600 lb, are automatically loaded into the furnace by a hydraulic charging machine, revolve slowly past flaming jets of gas, and are automatically discharged when heated to the required temperature. The billets, which are loaded radially on a huge revolving turntable turn slowly past 60 jets of flaming gas—40 around the furnace's outside circumference and 20 around the inside—and are heated from room temperature to 2300 F at the rate of 75 tons an hour. The furnace is a four-zone unit, with separate temperature controls on each zone. Gas-burning equipment and hearth- driving machinery is located in the center section of the furnace.

An elaborate electronic control system tells operators exactly what is going on inside the furnace at all times—even to the exact position of each billet within. Speed of turntable is recorded in feet per minute.

The furnace is encased in firebrick walls over a foot thick, backed up by five inches of insulating brick, and enclosed in steel plate. The suspended flat roof of the furnace, constructed of nine-inch firebrick, is hung on supporting beams, each tile suspended by a separate hanger especially designed to compensate for expansion and contraction during changes in internal temperature of furnace.

NEW ORE BRIDGE FOR BETHLEHEM PLANT

An example of new facilities designed to raise Bethlehem Steel Co.'s annual ingot capacity to 19,000,000 tons, this ore bridge has just been placed in operation at the firm's Bethlehem, Pa., plant. It is one of four bridges serving a stockyard capable of storing 1,200,000 tons of iron ore, obtained largely from the Great Lakes region. Fifteen-ton bucket loads ore into transfer cars.

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SALES AND SERVICE OFFICES IN PRINCIPAL CITIES FROM COAST TO COAST

Billets to be processed in this new rotary furnace will range in size from 3-in. to 8½-in. in diameter and from 4 ft 9-in. to 16 ft in length. All billets for the tube mill will be round. The red-hot billets emerging from the exit ports of the rotary furnace will go directly to the piercing mills of the new seamless tube mill.

A 100,000 lb per hr steam plant was sliced into sections, loaded on railroad cars in Kansas, and shipped to Pueblo to meet the greatly increased steam capacity required by the new seamless tube mill. The novel 500-mile moving job was performed in 17 weeks by teams of technical specialists and skilled craftsmen. CF&I's entire Pueblo steam generating system was completely rebuilt without a shutdown.

Big steam boilers have to be especially built for the job, and it takes about a year to build one. CF&I engineers canvassed the U. S. power industry to find one that could be converted for use in the Pueblo mill in a matter of weeks. They found one in an idle Sinclair refinery in Coffeyville, Kansas—a Walsh-Weidner sectional-head boiler. This unit was ideal because it could be dismantled immediately, was located close to a railroad, and was in "like new" condition.

Engineers of the J. F. White Engineering Corp. of Denver dismantled the apparatus, while CF&I engineers were preparing foundations for the boiler in Pueblo. The big boiler was cut into movable sections with acetylene torches, and the trip was made to Pueblo on five railroad cars. Transplanting of the jig-sawed boiler was accomplished without difficulty; 17 weeks later, it was cut into the Pueblo plant system. It is now carrying its share of the total load, while two new 100,000 lb per hr boilers are being installed. All three boilers will be in operation this month, plant engineers estimate.

Construction of the new mill and related facilities started in February, 1952, with 625,000 cu yd of earth being moved to prepare the site. The steel framework alone took five months to build. The completed mill, consisting of five long rectangular one-story buildings joined side by side, contains 37,000 cu yd of concrete and 10,000 tons of structural steel.

Mr. Franz announced that a backlog of orders for seamless tubing from

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(WIRED TELEVISION)

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"Utiliscope" Camera (above) and Receiver (below)

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the new mill has already built up, and that peak production will be achieved as quickly as possible. "Every member of the CF&I team can be proud of this new 'baby' of ours. It is one of the finest seamless tube mills in the world," Mr. Franz said.

MODERNIZE CEMENT PLANT AT UNIVERSAL, PA.

▲ Rebuilding of the 47-year-old Universal Atlas Cement Co. plant at Universal, Pa., underway since May, is about one-third completed, it was announced by Blaine S. Smith, president of the United States Steel Corp. subsidiary.

Mr. Smith pointed out that the new mill is a result of almost ten years of intensive research and experiment by company engineers under the direction of H. P. Reid, vice president in charge of engineering.

When the modernization program is complete, the new push-button mill will have only two large smoke stacks compared to the 38 which it now has. Engineering plans call for the installation of a mechanical dust collector and electrostatic precipitator to control stack emissions.

New construction is expected to be completed late in 1955, and will make the Penn Township plant one of the most modern cement plants in the United States.

This is another major project by U. S. Steel to reduce smoke and dust from Pittsburgh district operations. The latest in a series of moves by U. S. Steel, highlighting their "good neighbor" policy, was the completion of a cleaning plant at the Duquesne, Pa. Works to reduce smoke and dust from blast furnaces producing ferromanganese.

In connection with the modernization program, T. C. Wurtz, director of the Allegheny County Smoke Control Bureau, said: "I am sure that those living in Penn Township will be glad to learn that a new, essentially dust-free cement plant is now under construction by Universal Atlas Cement Co. This is another example of industry's fine cooperation in clearing the skies of Allegheny County and I congratulate the management of U. S. Steel and its subsidiary Universal Atlas Cement Co. on this forward step."

Design of the new mill calls for three new buildings to replace the

Cement dust is doomed at U. S. Steel's Universal Atlas Cement Co. plant at Universal, Pa. where work is underway to completely rebuild the 47-year-old plant, making it one of the most modern cement works in the United States. The tall kiln stacks in the background are among 38 to be dismantled. These will be replaced by two new stacks, completely equipped with a dust collector and electrostatic precipitator, left foreground, which will clean the stack emission before it is released into the atmosphere. The cylindrical shaped machines in the center are new rotating driers being installed in the raw mill.

four buildings which now house the coal mill, raw mill, burner mill and finishing mill. Razing of the old buildings and erection of the new mills is being accomplished without interruption of daily production. At the present time, one-half of the raw mill has been dismantled and three new driers have been installed to process ingredients necessary in the manufacture of cement. This equipment is expected to be in operation by November 15, 1953.

E. F. Harchelroad, who has been associated with the Universal plant for 38 years and plant manager since 1950, will be in charge of the new operation.

MACK-HEMP INITIATES CO-OP SCHOLARSHIP

▲ Mackintosh-Hemphill Co., steel mill roll and machinery manufacturer, is doing something about the shortage of college-trained engineers. The Pittsburgh concern is helping two of its employees, both high school graduates, to attend the University of Pittsburgh's School of Engineering & Mines, under co-operative work-in-industry program.

The student employees will go to school 10 hours each week and work 30 hours at various jobs in Mack-Hemp's plants. At the end of three years, they will be eligible for certificates of engineering fundamentals from the University.

Here's how the scholarship part of the program works: At the beginning of each semester, the student pays his own tuition. After he completes a course successfully, Mackintosh-Hemphill refunds one-half the tuition the student had previously paid.

When the first three years of the program have been successfully completed, Mack-Hemp refunds to the student the remaining half of the tuition already paid. This means that the company ultimately pays the entire tuition.

Tuition for the last three-and-one-half years will be refunded on the same basis.

BUILDS CONDENSER FOR FRENCH UTILITY

▲ A 60,000-kva synchronous condenser that will enable delivery of

The combination of heat and wear resulting from high speed travel as steel runs through a mill guide continually works towards its destruction. For this severe application a material is required which combines heat and wear resistance with adequate strength—all are inherent properties of these guides made by Rosedale Foundry and Machine Company.

Metal structure and physical properties are controlled to meet particular mill applications. Uniformity, absence of hard or soft spots, is essential for long service whether the required structure is soft ferrite or high strength pearlite. Free graphite of controlled size and distribution provides thermal shock resistance and lubrication.

Rosedale Foundry has the experience—built on supplying heavy duty castings for the nation's largest steel mills—to meet your requirements for severe applications. Any inquiry regarding possible applications of Meehanite castings will receive prompt attention from our engineering staff.

ROSEDALE FOUNDRY & MACHINE COMPANY
1731 Preble Ave., Pittsburgh 33, Pa. • CEdar 1-4007

in considerable volume, you may profitably make it yourself from coiled strip on a small, compact Yoder electric-weld tube mill. Daily production from 25,000 to 50,000 feet with only one operator and a helper. Amazingly simple and trouble-free, the new 4-in-1 Yoder welding transformer insures highest output of quality tubes at lowest cost per foot or mile.

Yoder Tube Mill Book tells complete and interesting story of the Yoder method and answers most pertinent questions about first cost and operating cost, minimum requirements for profitable operation, skill and training of operators, power consumption, weldable materials, tooling, etc. Send for it.

Latest Yoder development: Highly economical new process of making *aluminum, brass* and *other non-ferrous tubing* by cold forming and welding of coiled strip. Details on request.

THE YODER COMPANY
5495 Walworth Ave.
Cleveland 2, Ohio

Electric Weld
TUBE
MILLS

more usable power over the existing power system in the area surrounding Paris, France was recently shipped from the Port of Baltimore.

The 800,000-lb unit was manufactured at the East Pittsburgh, Pa. plant of the Westinghouse Electric Corp. Shipping was handled by Caldwell & Co., New York, acting for Electricite de France, which supplies that nation with electric power.

Size and weight of the machine, plus the fact it must meet manufacturing and operating tolerances as close as those of a fine precision watch, made necessary special shipping arrangements and precautions. After passing rigid tests at the factory, the condenser was dissembled into five major sections. Each piece was shipped separately on a special railroad car, which traveled only during daylight hours and at a speed not exceeding 20 miles an hour.

Heaviest piece is the 212,000-lb rotor; the largest is the 154,000-lb stator, which is 15 ft in diameter.

At Rouen, France, the equipment will be unloaded onto a special barge for transport down the Seine River. At Gennevilliers, it will be moved by cranes onto heavy trailer trucks for delivery to Harcourt Substation, 20 miles southwest of Paris, where it will be reassembled and placed in operation.

Harcourt Substation is a link in the national electrical system in France, which draws power from hydro-electric stations in the French Alps as well as from steam-electric generating stations in the north.

FOLLANSBEE AWARDED ORDNANCE CONTRACT

▲ Pittsburgh Ordnance District, has awarded a contract to Follansbee Steel Corp. for the manufacture of more than a million 50-caliber ammunition boxes. The contract is for $1,687,000. The boxes will be made in the firm's sheet metal specialty plant at Follansbee, W. Va.

The boxes, which hold 100 rounds of ammunition each, will be used for both storage and transport. They must be waterproof and airtight, and must withstand 200 hours' exposure to a salt spray test.

Ordnance District personnel explain that the boxes may be used to store ammunition over long periods of time, or may see hard service in forward combat areas.

TO PACKAGE NAILS IN FIBREBOARD UNITS

▲ The old familiar nail keg may soon suffer the same fate as the cracker barrel. Modern packaging methods and a newly developed fibreboard carton are likely to make the wooden keg a museum piece.

Atlantic Steel Co., Atlanta, Ga., is the first major nail producer to adopt the new fibreboard carton, called the "Nail Caddy," developed by International Paper Co.

Although other steel companies have used fibreboard containers during the past few years, this is the first time a mill has completely abandoned kegs and made plans to package its full line of nails, rivets, and staples in cartons.

Robert S. Lynch, president of Atlantic Steel Co., stated, "Adoption of the new carton, together with the installation of a new nail cleaning unit, a conveyor system and automatic sealing unit makes our nail cleaning and packaging operation the most modern in the industry."

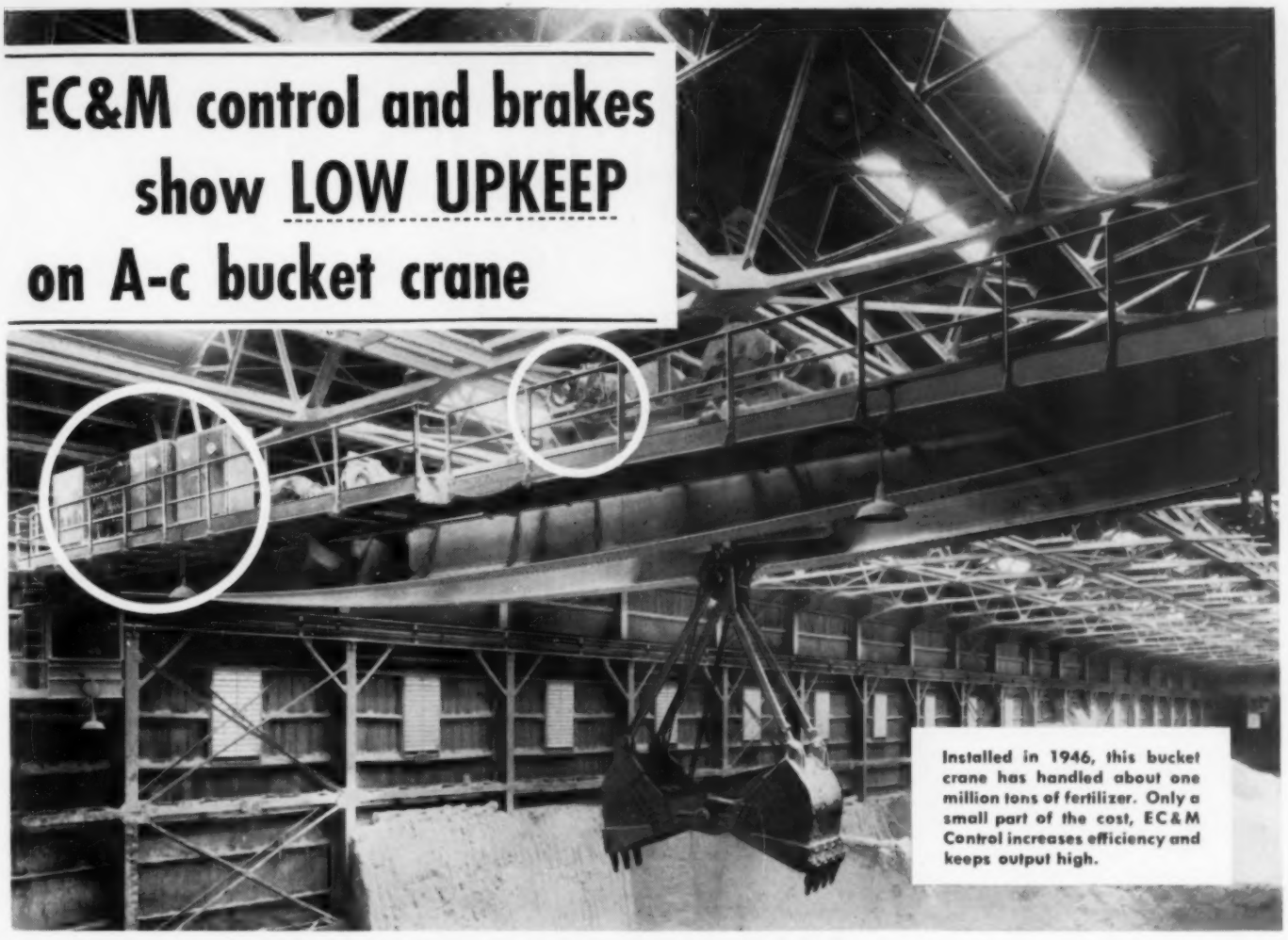
"The new nail cleaning unit is the only one in which a wet mill, a dry mill, and weighing operation are integrated into one continuous automatic operation." he said.

The conveyor set-up and sealer is also the first installation of its kind used to automatically seal the new cartons.

DRAVO MOVES HEATING DEPARTMENT OFFICES

▲ Dravo Corp., Machinery Division, Pittsburgh, Pa., announces that as of October 1, 1953, its Heating

EC&M control and brakes show LOW UPKEEP on A-c bucket crane



Installed in 1946, this bucket crane has handled about one million tons of fertilizer. Only a small part of the cost, EC&M Control increases efficiency and keeps output high.

RENEWAL PART Cost only $1.40 per 1,000 tons of fertilizer handled during 7 years of operation.

Sounds good and is good—but read the complete story of how EC&M Control Apparatus has given almost perfect service . . . operating 12 hours a day throughout nearly 7 years on this A-c bucket crane in an eastern fertilizer plant. EC&M Controllers and Type WB Brakes have required few replacement parts. Maintenance has been on a routine basis during normal idle periods. EC&M Type WB Brakes and EC&M Frequency Relay Control have operated with *no production delay in 7 years.*

This is typical of the performance of EC&M Control Apparatus on every type of material-handling crane. Cab-operated or floor-operated; a-c or d-c motored. Before buying cranes, contact our nearby office for recommendation on control that will promote high-speed production at low upkeep. It pays to specify EC&M Control for cranes.

NEVER HAD IT SO GOOD!

EC&M LINE-ARC Contactors are known for low upkeep

1. No destructive arc shield burning in 7 years—only 3 broken shields replaced.
2. 14 contactor coils have operated continuously with only one replacement.
3. Contacts renewed on an average of once a year on one size and once every two to three years on the other size. No replacements on largest size contactor.

EC&M WB Brakes solve the A-c Brake Problem*

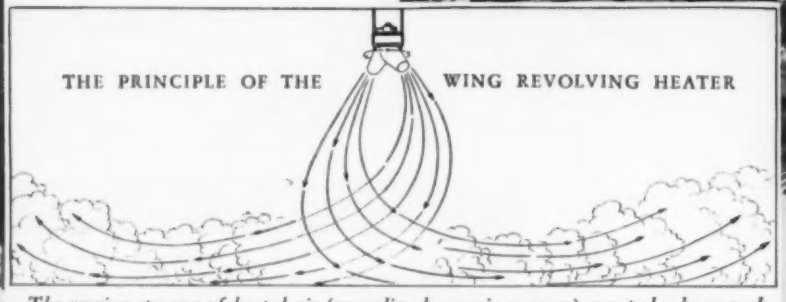
1. Brakes relined on an average of every 18 months.
2. Not a single brake-coil failure.

*Fast-releasing—fast-setting—no chatter, hum or hammer.

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

HEAT THAT MOVES AROUND

THE fact that the discharge outlets of WING Revolving Unit Heaters keep the heated air in constant, gentle motion is one of the reasons why nationally known firms like the Budd Company have installed them in their plants, both at Philadelphia and in the one shown in this photograph, at Gary, Indiana. The big blanking and forming presses in this great plant present a natural barrier to ordinary fixed discharge heating systems, but not to the moving streams of heated air from the WING Revolving Heaters, even suspended, as they must be, far above the floor, to clear the cranes. That is equally true in the summer time when, with steam turned off, the cooling breezes from the revolving discharge outlets keep workers comfortable on the hottest days. Investigate. Write for Bulletin HR-6.



The moving streams of heated air (or cooling breezes in summer) sweep slowly around through 360 degrees, covering successively every direction. The air velocity is sufficient to carry to walls, and remote corners and the constantly changing direction of flow causes the air to find its way around obstructions.

Wing

L. J. Wing Mfg. Co.
142 Vreeland Mills Road
Linden, New Jersey
Factories: Linden, N. J. and Montreal, Can.
In Europe: Etab. WANSON, Brussels, Belgium

Department headquarters will be located in the Chamber of Commerce Building, 411 Seventh Avenue, Pittsburgh 19, Pa.

According to W. L. Davidson, sales manager of the Heating Department, increased sales of the "Counterflo" and suspended gas fired heaters, and the introduction of Dravo's new "Paraflow" oil fired heater has forced the department to move to larger quarters.

With almost twice the floor area available, the new location will permit expanding the department's facilities as needed to serve Dravo's new commercial and industrial customers, yet keep the group closely knit for effective co-ordination of its various activities.

CONVERT BLAST FURNACE TO FERRO PRODUCTION

▲ Ferromanganese production was doubled at United States Steel's Duquesne, Pa., Works with the conversion of No. 1 blast furnace from iron to ferro.

First step in the conversion ironmaking is a cast of spiegeleisen—a product which is about 80 per cent iron and 20 per cent manganese.

When the balance is reversed and manganese percentage of No. 1 furnace output goes over 70 per cent, the product will be stabilized as ferromanganese.

The change-over of No. 1 blast furnace closely follows the start-up of the ferromanganese gas cleaning plant at Duquesne Works—first of its kind to be installed in any steel plant.

No. 1 will be Duquesne's second blast furnace to change over from iron to ferro production, No. 2 having been in ferro production for some time. The 300 ton daily output of No. 1, added to the present 320 ton daily output of No. 2 furnace, tags Duquesne as United States Steel's principal ferromanganese producer.

MEETING WILL FEATURE PAPER BY LABOR LEADER

▲ The Pittsburgh District Section of the American Materials Handling Society has a very interesting paper scheduled for Thursday evening, November 19, 1953. This paper is entitled "Labor's Views on Materials

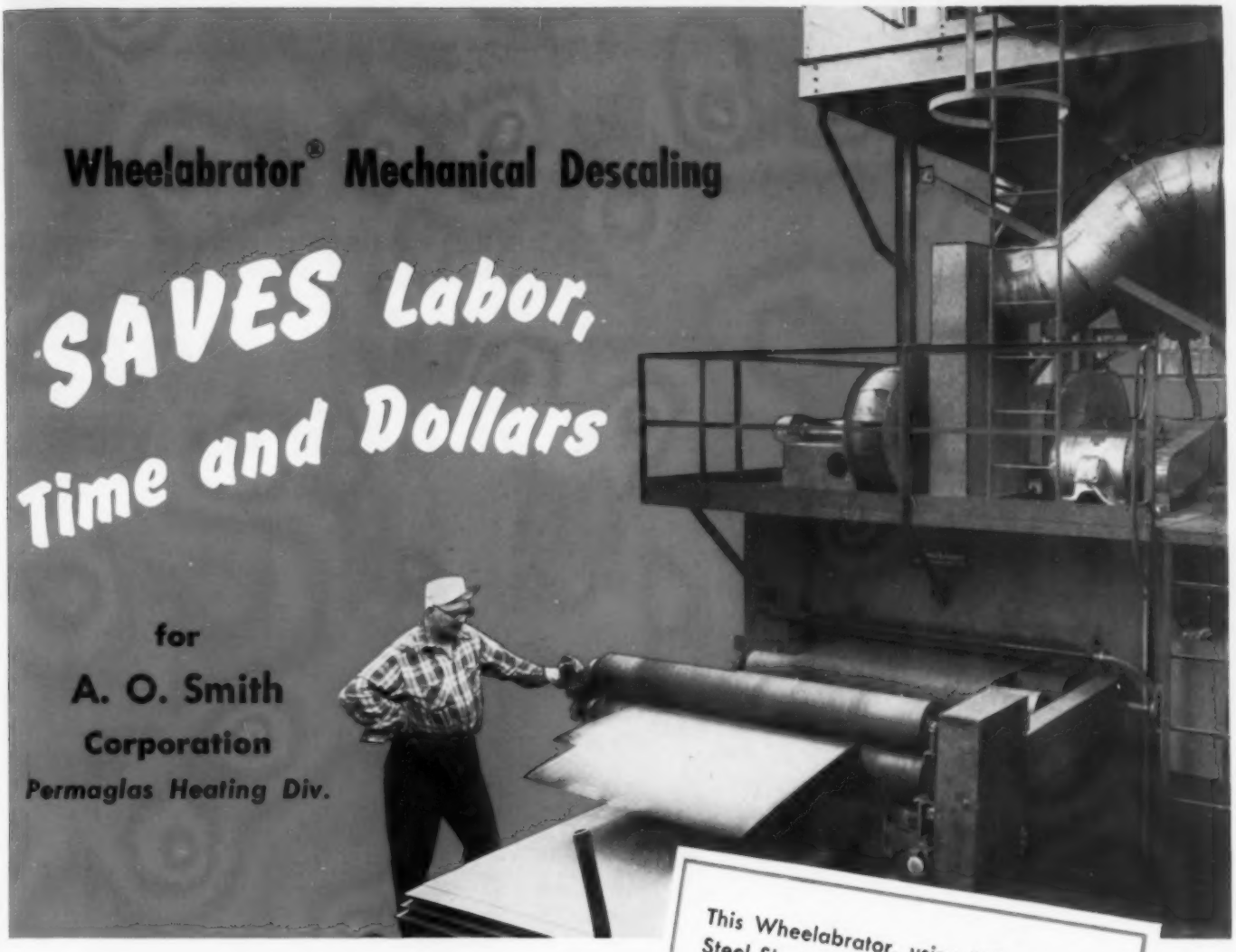
Wheelabrator® Mechanical Descaling

SAVES Labor, Time and Dollars

for

A. O. Smith Corporation

Permaglas Heating Div.



This Wheelabrator, using Wheelabrator Steel Shot, descales steel sheets averaging 48" wide. Cleaned steel is fed to the finish pile preparatory to moving it to a blanking and piercing machine and thence to tank forming and welding.

The Permaglas Heating Division of A. O. Smith Corp. has cut costs by using Wheelabrator airless blast cleaning for descaling steel sheets required in their water heater production. They have found that this process does an excellent job of descaling and at the same time saves labor, time and money.

This perfected airless centrifugal blast process, pioneered by *American,* uniformly scours away scale and dirt mechanically at low cost. It produces a surface which is superior to a pickled surface for all cold-working operations. The sheets will draw better, weld better, and when stored without oiling will resist rusting better than does pickled stock.

The Wheelabrator offers profitable advantages for steel producers and processors alike. It provides a more uniform etch for mill rolls and effects unusual economies in cleaning strip, sheet, bar stock and skelp.

If you Produce or buy Hot Rolled Sheet or Strip - - Wheelabrate for Substantial Savings

Send today for your copy of Bulletin 914, telling "How to Cut Steel Costs by Mechanical Descaling":

American

WHEELABRATOR & EQUIPMENT CORP.

396 S. Byrkit St., Mishawaka, Ind.

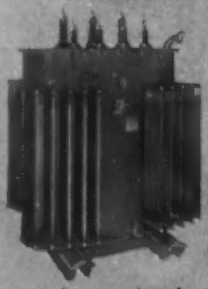
Wheelabrator®
AIRLESS BLAST CLEANING

Today's best buy!

PENNSYLVANIA
Standard Parts
POWER TRANSFORMERS

Faster deliveries are assured

when you order Pennsylvania Standard Parts Power Transformers. That's because quantity production methods of manufacturing, coupled with the use of standard designs and standard parts, shorten engineering and production time.



A wide range of optional voltages

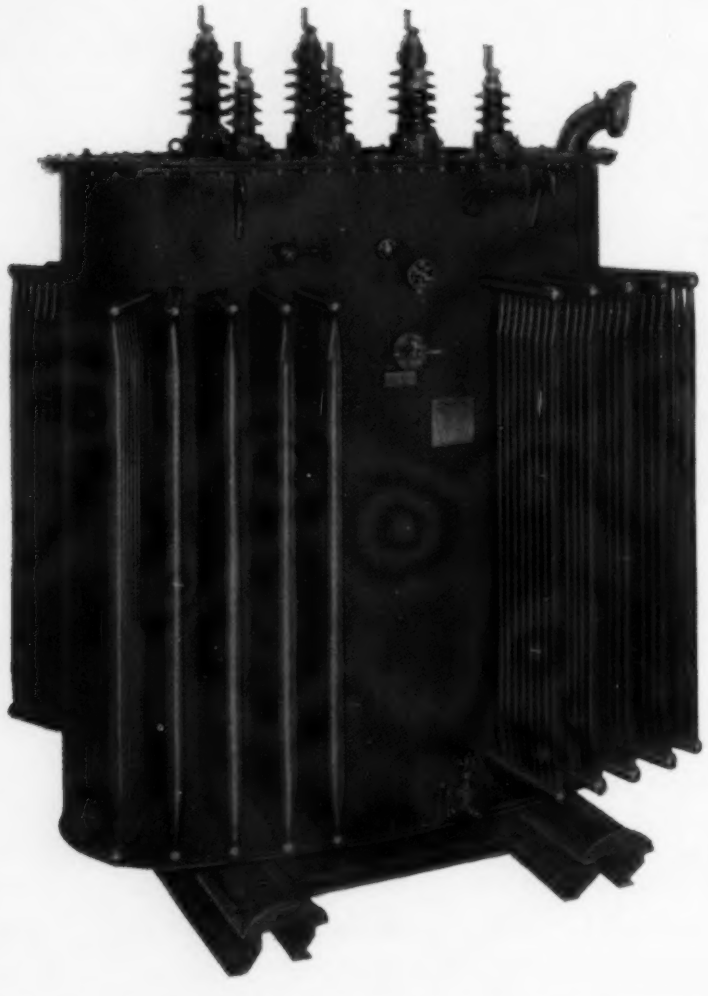
is permitted with Pennsylvania Standard Parts Power Transformers, including 2 taps above and 2 taps below the primary voltage.

You have a choice of the method of oil preservation

in the larger ratings of Pennsylvania Standard Parts Power Transformers.

Optional equipment such as

current transformers, high voltage switches, etc., are available with Pennsylvania Standard Parts Power Transformers at regular prices, without any penalty being added to the base price of the transformer.



If your requirements call for power transformers in sizes up to 5,000 Kva, single phase, and 10,000 Kva, three phase — 69 Kv or less — then by all means find out about Pennsylvania Standard Parts Power Transformers. You will save up to 8% in capital investment, and get quicker deliveries. An example of this is the 2500 Kva, three phase Pennsylvania Standard Parts Power Transformer pictured above. This transformer cost the purchaser $1026.00 less because he specified Standard Parts.

Pennsylvania Transformer Company

A McGRAW ELECTRIC COMPANY DIVISION

CANONSBURG, PA., Greater Pittsburgh District

Handling," by Frank Burke, safety and health director, United Steel Workers of America, Pittsburgh, Pa. This meeting is a dinner meeting with dinner starting at 6:30 p.m., and the paper is scheduled for 8:00 p.m. at the Sheraton Hotel, Pittsburgh, Pa. Mr. Carleton Lord, materials handling consultant, United States Steel Corp., Pittsburgh, Pa. is chairman of the Pittsburgh district of the AMHS.

CONSTRUCT BAR MILL FURNACES AT PUEBLO

▲ A new bar mill furnace has been completed and a second is under construction for the Colorado Fuel and Iron Corp. at its Minnequa Works in Pueblo, Colo., according to the Rust Furnace Co., the engineer-constructor.

The furnaces are of the Rust zone-controlled continuous type, triple fired and non-recuperative, with a capacity of 60 tons per hour. Both furnaces have inside widths of 20 ft with an effective heating length of 61 ft. They will be equipped for firing with natural or coke oven gas.

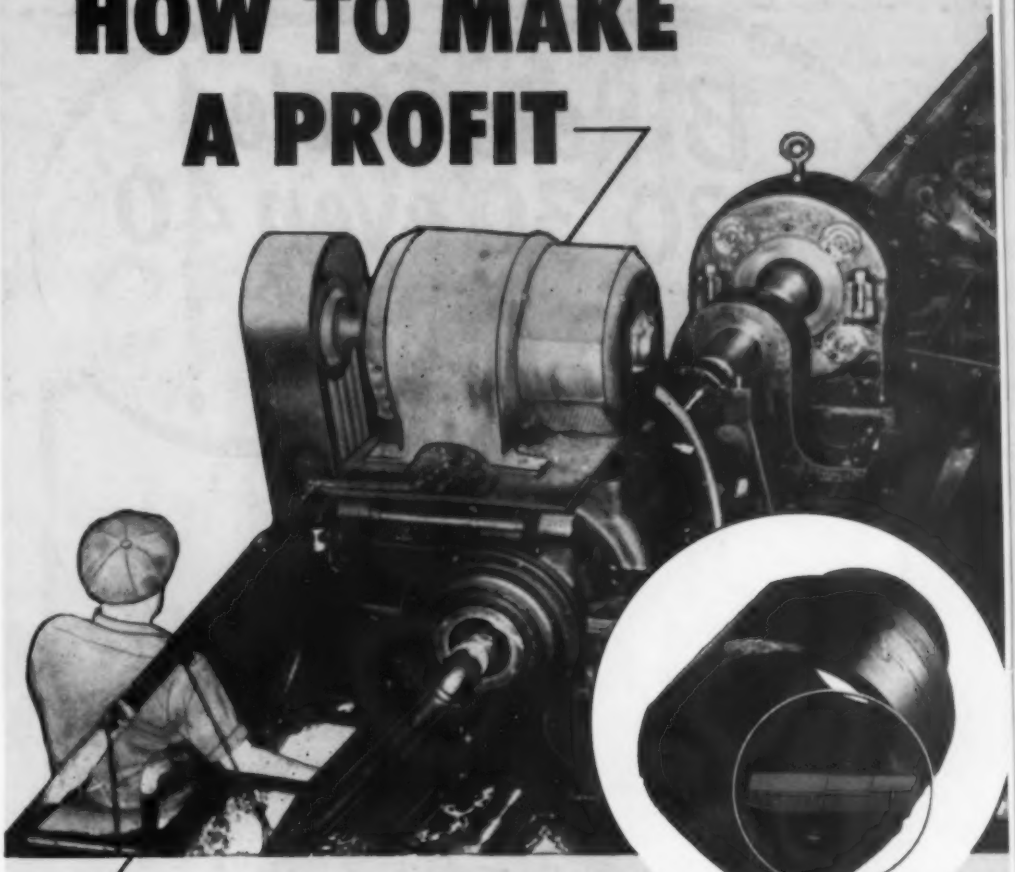
SQUARE D EXPANDS MILWAUKEE OFFICES

▲ Described as the nation's "most modern office building," a new 48,000 sq ft, two-story addition to the Square D Co.'s Milwaukee, Wisc., plant provides for "assembly line" flow of office functions.

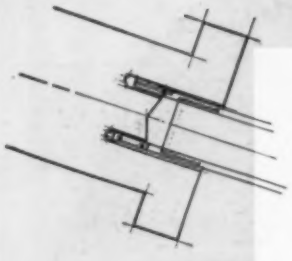
Newly opened after completion of construction started in June of last year, the office building brings to more than 450,000 sq ft the company's total working area in this city, and represents the fifth Square D expansion project in Milwaukee since 1940. While the new building houses office functions exclusively, the transfer of those functions from existing quarters makes available additional space for production and research facilities. For example, the new research laboratory will move into some vacated space to become a centralized laboratory twice as large as earlier scattered facilities.

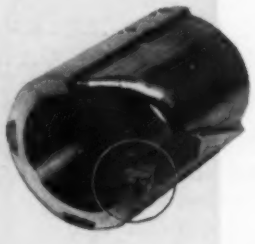
Unusual features of the new office building include an air conditioning system supplying cooled and dehumidified air to the office space by way of millions of holes in metal ceiling

HOW TO MAKE A PROFIT



BY GOING IN THE HOLE





Kennametal triple-edge tool trepans 4½" diameter hole through 30' workpiece at rate of 8 ft./hr. Three-inch core resulting from operation is usable for small diameter parts — a worthwhile saving in material.

Drilling or trepanning deep holes with Kennametal has saved hours of time — added dollars to operating profit. Here are two examples:

To drill a 30 ft., 3" hole in chrome-nickel-moly steel with HSS spade drill required 12 hours. An off-center, triple-edge Kennametal drill head (shown above) did the job in 2 hours.

To trepan a 30 ft., 4½" diameter hole in forged steel with HSS spade drill consumed 90 hours. A triple-edge Kennametal tool (shown at left) reduced the time to 8 hours.

Complete details of these two operations furnished on request. They are typical of a wide range of metal-working jobs on which Kennametal tooling has proved to be a profitable investment.
Kennametal Inc., Latrobe, Pa.

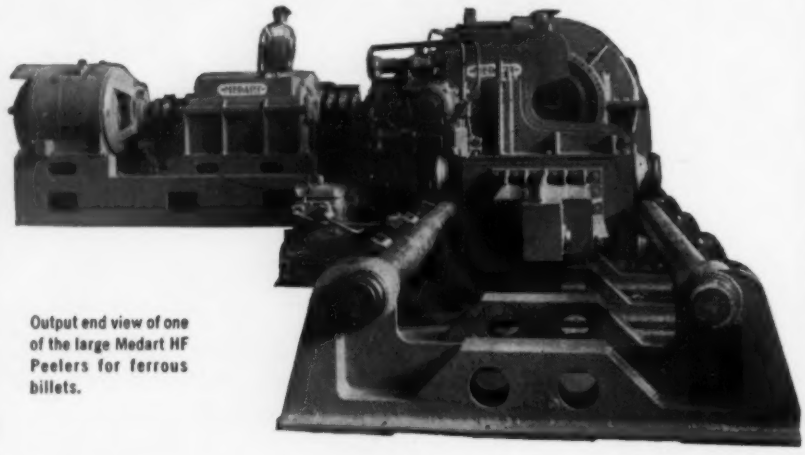
KENNAMETAL
CEMENTED CARBIDE TOOLING
THAT INCREASES PRODUCTIVITY

Billets Peeled at 20', 30', even 40' Per Minute!

MEDART

MODEL HF

BILLET PEELERS



Output end view of one of the large Medart HF Peelers for ferrous billets.

The output of Medart Billet Peelers is limited only by the capacity of the best available cutting tools! That means the absolute maximum in production at the lowest possible cost!

Built to handle both ferrous billets from 1" to 14" diameter — as well as brass, copper, aluminum and other non-ferrous metals — the throughput speeds of these Medart Peelers range from 1' to 40' per minute, depending upon workpiece size and material. They can be equipped with either one or two cutterheads — arranged for high surface finish or heaviest hogging cuts — and furnished with hydraulic or pneumatic controls, with push-pull feed devices, and for completely automatic operation.

No other scalping or turning machines made can match the production speed or economy of Medart's complete line of Billet Peelers.

Write NOW For Catalog!

THE MEDART COMPANY 3535 DE KALB STREET ST. LOUIS 18, MISSOURI

tile. In making the entire surface of the ceiling serve as distribution duct for air conditioning, the design eliminates drafts. Water used for air conditioning also serves to cool the roof through a system of sprinklers.

WELD PIPE PRODUCTION BEGINS AT FAIRLESS

▲ Production of continuous weld pipe has started at the Fairless Works of National Tube division of U. S. Steel Corp. Thomas C. Beattie, general superintendent. Initial operation at this plant was attained with the rolling of 1½-in. diameter pipe on the first of two continuous weld mills. The skelp mill which produces products for pipe manufacture and certain finishing facilities are also in operation.

Facilities at National Tube include a skelp mill, two continuous weld mills for producing pipe from ½-in. to 4-in. in diameter, galvanizing and finishing departments and a 30,000 ton capacity warehouse. The National Tube plant has an annual capacity of 281,000 tons of pipe.

SPRING AND AXLE FIRMS ANNOUNCE MERGER

▲ The anticipated consolidation of The Timken-Detroit Axle Co. and Standard Steel Spring Co. to form the Rockwell Spring and Axle Co. became a reality on October 1 bringing into being an industrial organization with assets of more than $155,000,000.

The two predecessor companies will continue under their own names as divisions of Rockwell Spring and Axle Co. Rockwell Spring and Axle Co. currently maintains 24 plants strategically located in 19 cities. More than 19,000 persons are in the employ of the new company. No plant management changes are contemplated.

APPOINTS SALES AGENT FOR WESTERN REGION

▲ George J. Hagan Co. of Pittsburgh, Pa., announce the appointment of W. P. Woolridge Co. of San Francisco, Calif., with branch offices in Los Angeles and Salt Lake City,

Utah, as their sales representatives for the western territory. Particular emphasis will be given to Hagan automatic rotary hearth furnaces.

W. P. Woolridge Co. has been on the Pacific Coast since 1932 and was associated with Columbia-Geneva Steel Division of U. S. Steel Corp., Pacific States Steel Corp. and Kaiser Steel in sales engineering capacities.

DOWELL, INC. OPENS NEW DISTRICT HEADQUARTERS

▲ Dowell Inc. is now occupying new district headquarters at Depew, N. Y. The new construction includes sales and service offices, two warehouses, dock, 15,000 gal solvent storage tank and garage for storage and maintenance of trucks. The new buildings are on the New York Central Railroad at 952 Edicott Road.

ANNOUNCE FORMATION OF TWO NEW DIVISIONS

▲ Establishment of two company operating divisions—industrial and automotive—has been announced by Electric Storage Battery Co., manufacturer of Exide batteries. The action further effectuates plans, including improvement of physical facilities, which have been under development for several years.

Roland Whitehurst, vice president and director, has been appointed general manager of the firm's new industrial products division. Heading the new automotive products division as general manager is Robert L. Sommerville, formerly assistant general sales manager.

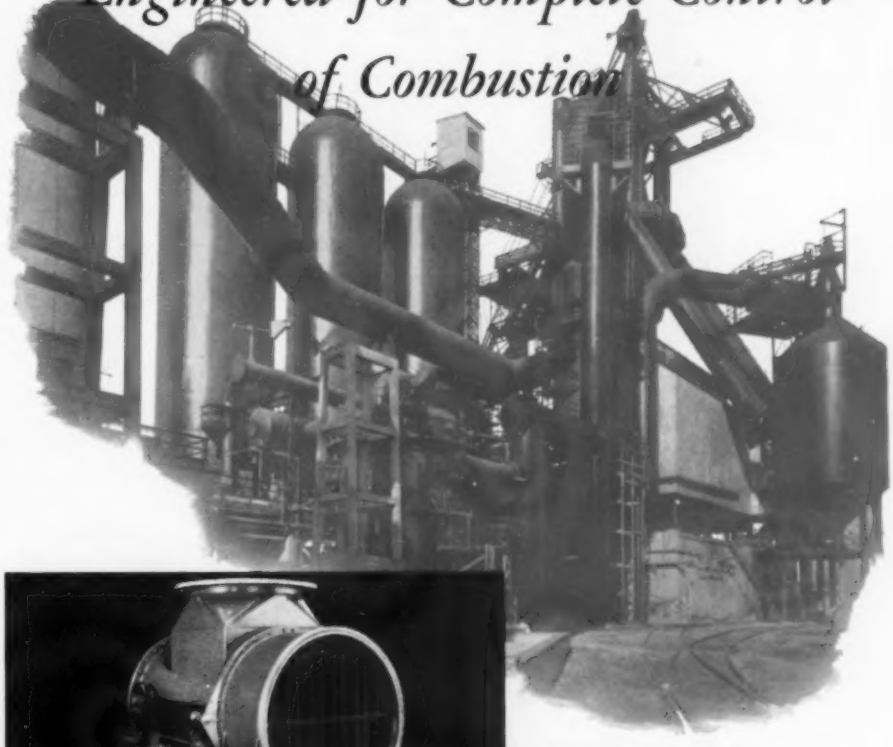
WILL PRODUCE SILICA BRICK IN CALIFORNIA

▲ The demand by western industries for silica refractories has resulted in Harbison-Walker Refractories Co.'s decision to start producing "Vega" super-duty silica brick at its Warm Springs, Calif. Works. Until recently the Warm Springs operation was devoted exclusively to the manufacture of basic refractories.

At Warm Springs, the brick will be manufactured from materials from the company's mining operations on the West Coast. Harbison-Walker also produces this type brick at Athens, Tex. and at Windam, Ohio.

MOHR GAS BURNERS

Engineered for Complete Control of Combustion



Another important contribution to dependable blast furnace operation is this Mohr Gas Burner, engineered for long life and low maintenance.

Operational advantages resulting from the advanced design of Mohr gas burners include proportioning control of combustion; intimate mixing of gas and air introduced in alternate layers; control of both dome and flue temperature; and absence of puffing at maximum gas flow. ★ The unit illustrated is a 36-inch diameter burner which burns up to 25,000 cubic feet per minute. Other sizes are available to meet individual requirements.

Engineers Fabricators Contractors Since 1881

JOHN **MOHR** & SONS

3200 East 96th Street—Chicago 17, Illinois

It pays to buy USG® BRUSHES

For crane motors — mill motors — tin line generators
— for all rotating electrical equipment —
USG BRUSHES are best.

Our brush engineers can analyze and solve those tough application problems. Give our experienced representatives a chance to prove it with a performance test.

WRITE US TODAY
ASK FOR OUR CATALOG

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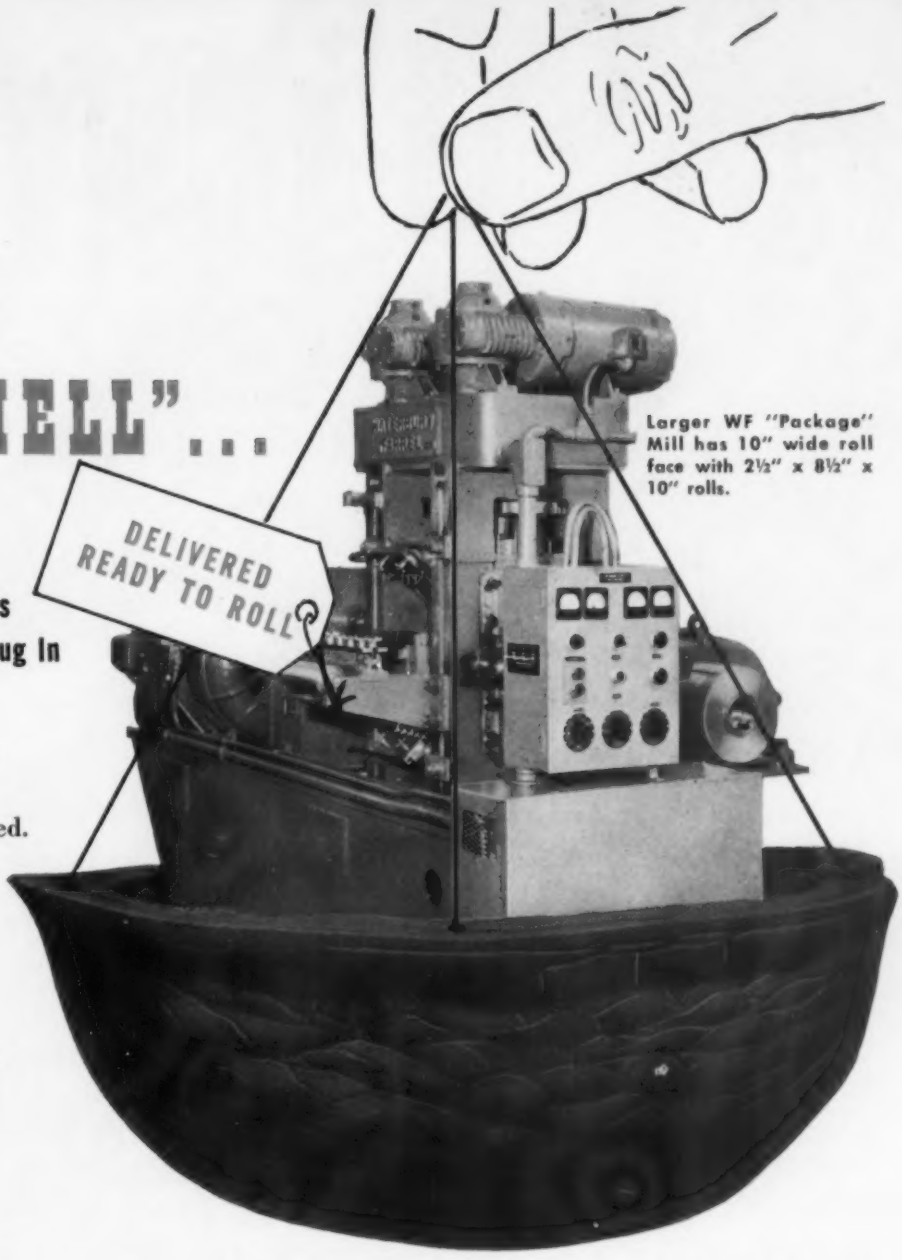
THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

Waterbury Farrel's
New, ONE-PIECE

STRIP MILL "IN-A-NUTSHELL"...

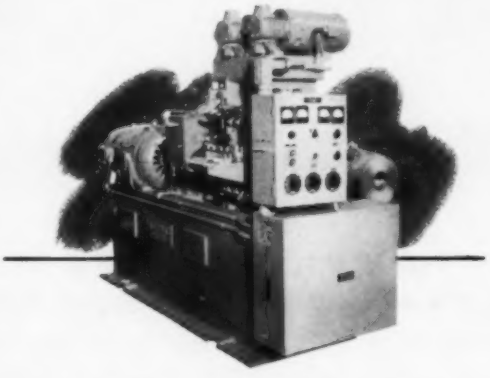


Larger WF "Package" Mill has 10" wide roll face with 2½" x 8½" x 10" rolls.

WF's 4-High "Package" Rolling Mills Are Compact, Low Cost, Ready To Plug In

You can start precision-rolling ferrous or non-ferrous strip as soon as you plug in the electrical connection.

This mill is completely self-contained. Drive, gear case, controls, lubrication system, winder and winder drive are assembled with the mill, itself, into a single, compact unit. When necessary, it can easily be moved in one piece to a new location.



Smaller WF "Package" Mill has 6" wide roll face with 1⅝" x 6½" x 6" rolls.

Some Construction Features: Mill frame of unit welded plate steel gives maximum strength and rigidity . . . assures greater accuracy and lasting alignment . . . alloy steel work rolls mounted in needle bearings . . . alloy steel back-up rolls drilled for water cooling, mounted in double row Timken bearings with tapered sleeve . . . independent power screwdowns . . . long and short roll necks and staggered couplings permit heavier construction for maximum torque capacities . . . lucite cover on welded steel gear case facilitates inspection . . . variable speed tension control drive, using AC power, cuts control cost and permits compact panel.

Contact Waterbury Farrel for complete details. No obligation.

WATERBURY FARREL FOUNDRY & MACHINE CO. • WATERBURY, CONN.

Offices: Chicago, Cleveland and Millburn, N. J.

A FEW OF THE MANY TYPES OF METAL WORKING MACHINERY MADE BY WATERBURY FARREL

MILL MACHINERY—Rolling Mills: Strip, Rod, Wire Flattening, (For Ferrous and Non Ferrous Metals) • Also Slitters • Straighteners • Cut-off Saws • Coilers • Winders, etc. *WIRE MILL EQUIPMENT*—Continuous Wire Drawing Machines (Upright Cone and Tandem) • Wire Flattening Mills • Chain Draw Benches • Pointers Swagers • Bull Blocks • String-up Machines • Spoolers, etc. *COLD PROCESS BOLT & NUT MACHINERY*—Headers (all types) • Rivet Machinery • Trimmers • Thread Rolling Machines • Slotters • Nut Formers and Tappers, etc. *POWER PRESSES*—Crank, Cam and Toggle; also Rack and Pinion Presses • Eyelet Machines Multiple Plunger Presses • Horizontal and Hydraulic Presses, etc.

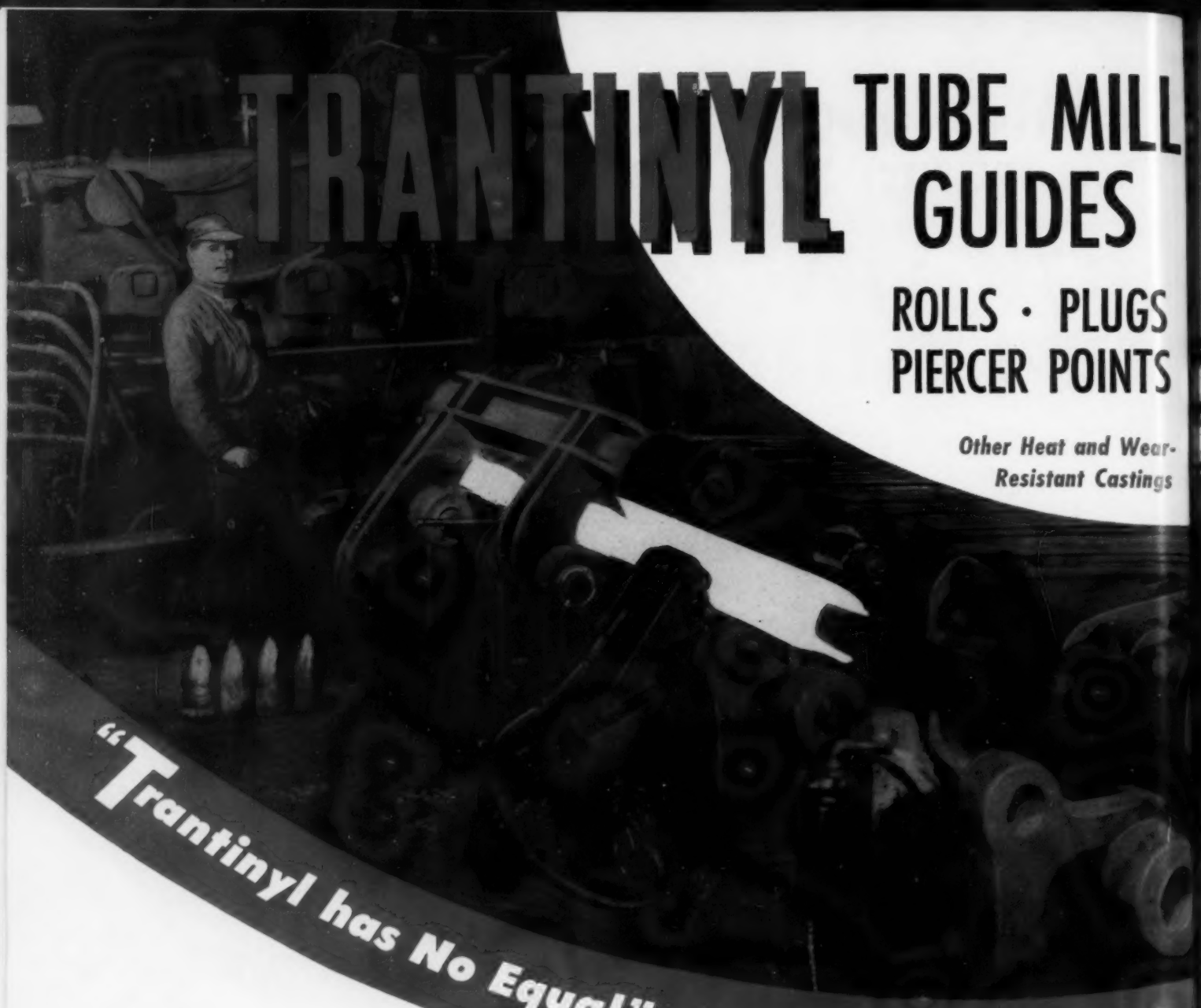
WATERBURY FOUNDED 1851 FARREL

WF-17

TRANTINYL TUBE MILL GUIDES

ROLLS · PLUGS PIERCER POINTS

Other Heat and Wear-Resistant Castings



"Trantinyl has No Equal"— say Tube Mill Men!

Reduces Down Time . . . and Aids Profitable Operation

". . . a single set of Trantinyl alloy guides will stand up in our mill during the piercing of as many as 20,000 hot steel billets." • "Instead of being changed frequently, they will remain in the mill in good condition for as long as one to two weeks at a time. We have never been able to find another guide shoe that will equal this . . ." • "We have had as many as 5800 hot billet passes rolled over one single plug . . ." • ". . . Youngstown Alloy Casting Corporation (products) have contributed much toward our success in manufacturing Seamless Tubing of a very high quality."

"TRANTINYL GUIDES THE STEEL INDUSTRY"

SEAMLESS TUBE MILLS:
guide shoes, rolling mill plugs and rolls, piercer points, etc.

ELECTRIC WELD TUBE MILL:
forming rolls, planishing rolls, tool holders, etc.

ROLLING MILLS:
bar, hoop, strip, shape mill guides; and rollers

STRAIGHTENING MACHINE GUIDES · HEAT RESISTING CASTINGS
"TRANTINYL No. 1" CAST TO SHAPE

T3

Youngstown Alloy Casting Corp.
Youngstown, Ohio

A Fast Start!

NEW GRANITE CITY "BLOOMER" GOES INTO PRODUCTION WITHOUT SHAKEDOWN

All control for main and dc auxiliary drives in the new blooming mill at Granite City Steel was supplied by Allis-Chalmers. Significantly, near capacity production started immediately . . . without a costly shakedown. In fact, eight days later the old mill was taken out since it was apparent that standby equipment was not needed.

Noteworthy, too, is the fact that the installation was completed *on time*. Controls were factory assembled, thus simplifying and speeding installation.

Progressive Granite City Steel has standardized on Allis-Chalmers electrical equipment in its large expansion program. The recently completed blooming mill is the first stage in a three-stage plan. When completed, this realistic, farsighted expansion will push production to well over a million ingot tons annually.

Why not put Allis-Chalmers skill and experience to work for you? Call your nearby A-C steel mill representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4114

Pictured above are some of the Allis-Chalmers control installations at Granite City Steel.

Left— *Regulex* amplifier exciter sets provide sensitive control for variable voltage dc drives.

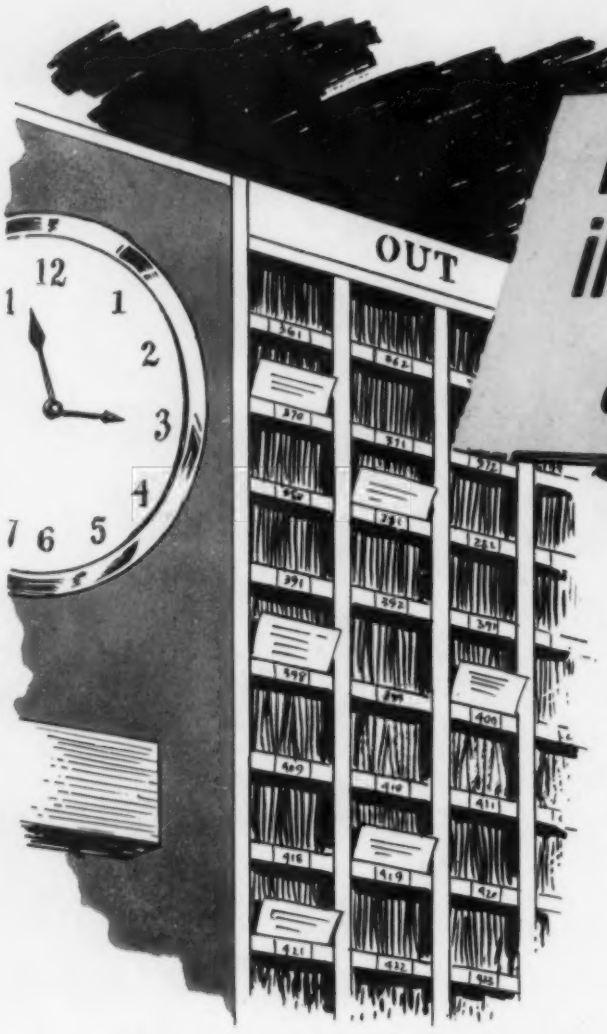
Center — Constant voltage control panels for dc auxiliary drives.

Right— Liquid rheostat provides stepless speed control for 7000-hp m-g set.

Regulex is an Allis-Chalmers trademark.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS



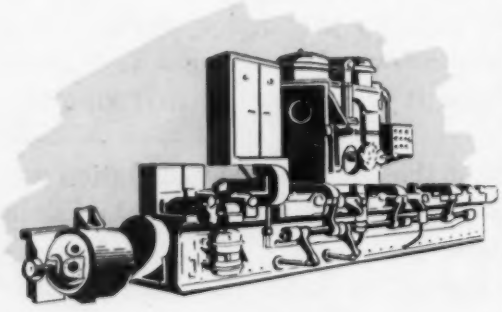
keep their cards in the racks and active!

ABSENTEEISM AND LABOR TURNOVER IN BILLETSHED EFFECTIVELY SOLVED BY BONNOT BILLETEER

It replaces dangerous, ear-splitting, nerve-wracking drudgery with smooth, precision mechanical "chipping" under safe and easy, finger-touch control.

"Billeteering" ends absenteeism due to "nerves," fatigue and job-dislike. It puts billetshed work on a par with other "operator" jobs in the mill . . . makes the billetshed a preferred place to work.

What's more... the Bonnot Billeteer provides a steady, dependable supply of conditioned billets, permitting reduction of inventories and eliminating disruption of rolling schedules. Chips are 100% recoverable . . . excessive re-melting is eliminated . . . the job is done better, 10 times faster AND AT A SAVING OF 56%.



If labor-force stability, dependable scheduling and lower costs are important to you, it is important that you have all the data on "Bonnot Billeteering."

Engineered For Improved Production

The Bonnot Co.
STEEL EQUIPMENT DIVISION
CANTON 2, OHIO

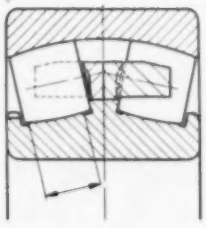
Also Manufacturers of — SAWING • PULVERIZING AND MIXING EQUIPMENT • BILLET INSPECTION TABLES CRUSHING • DUST PUG MILLS • SINTER PLANT PUG MILLS

the SKF

improvement of internal design of spherical roller bearings

Increases capacity 25% to 50%

increases service life 2 to 3½ times

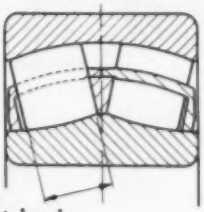


This is the Spherical Roller Bearing design originated by SKF *more than 30 years ago.* The cross-section shows how the integral inner ring flanges, and the undercuts adjacent thereto, limit the effective length of the rollers.

Now, SKF, originator of the Spherical Roller Bearing, has again provided industry with another anti-friction *first.*

This time, it's a revolutionary design advance in Series 222 and 223 bearings providing these advantages:

When designing new equipment, you can obtain the desired life by using smaller or lighter bearings at considerable cost saving. In addition, this forward step in design will carry heavier combinations of radial and thrust loads, or pure thrust loads of greater magnitude. The important self-aligning feature of SKF Spherical Roller Bearings has been preserved, so that considerable misalignment between the shaft and housing has no ill effect whatever on bearing capacity or life.



Here is the latest SKF improvement, a *revolutionary advance in design.* Effective roller guiding is accomplished by means of a separate ring. The need for undercuts is eliminated! This type of guide ring permits the rollers to take the position which their contact with the rings dictates. This assures uniform load distribution over the entire length of the longer rollers at all times. *Result*—greatly increased capacity and life.

During more than 4 years, thousands of installations have been made in railroad journals, vibrating screens, steel mill machinery and numerous other fields. In all cases performance has been outstanding.

SKF Sales Engineers in our District Offices throughout the country will assist you in making use of the important advantages of the improved internal design of SKF Spherical Roller Bearings. **SKF INDUSTRIES, INC.,** Dept. 616, PHILADELPHIA 32, PA.
— *manufacturers of* **SKF** *and* HESS-BRIGHT *bearings.*
7424

SKF®
BALL AND ROLLER BEARINGS

This 12-page booklet gives you additional facts—sizes available—added capacity, size by size—increased life you can expect for each size—dimensional tabulations—and load and speed data. Write now for your free copy of Booklet No. 365-2.

© 1953, SKF INDUSTRIES, INC.,

Keep NATIONAL Carbon Brick on hand for MAINTENANCE

TRADE-MARK

KEEP THESE STANDARD SIZES ON HAND FOR EMERGENCY!

13½" x 6" x 3" series
9" x 6" x 3" series
9" x 4½" x 2½" series

☆

Write for Catalog Section S-6210

If you think of carbon only in terms of complete furnace linings, check these other important locations in and around the furnace where "National" carbon brick and shapes will also save time and money as a maintenance refractory:

- ✓ ***RUNOUT TROUGHS***
- ✓ ***CINDER NOTCH LINERS***
- ✓ ***CINDER NOTCH PLUGS***
- ✓ ***SPLASH PLATES***
- ✓ ***SKIMMER PLATES***

. . . and Many More!

The term "National" is a registered trade-mark of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY

A Division of Union Carbide and Carbon Corporation, *30 East 42nd Street, New York 17, N. Y.*

District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

In Canada: National Carbon Limited, Montreal, Toronto, Winnipeg

Personnel News...

William E. Boger has been appointed general superintendent of the Alan Wood Steel Co., Conshohocken, Pa.

Seward H. French, Jr., was appointed a vice president of Crucible Steel Co. of America, Pittsburgh, Pa. Mr. French will be in charge of industrial and public relations and be the company's spokesman in these matters. Mr. French joined Crucible in 1947 as assistant to the president in charge of industrial and public relations and established headquarters in Pittsburgh, where the general offices are now located.

William M. Frame has been named as director of research and technology of United States Steel Corp.'s National Tube Division. Mr. Frame will succeed **O. P. Adams,** who is retiring. Since joining U. S. Steel's National Tube Division in 1952, Mr. Frame has been executive assistant, operating department.

Walter J. Prochak has been appointed assistant superintendent of the cold drawn bar department at Brier Hill works of Youngstown Sheet and Tube Co., Youngstown, Ohio. Mr. Prochak has been serving as metallurgist at this plant.

John K. Deasy has been named traffic manager, Weirton Steel Co., Weirton, W. Va., to succeed **A. S. Earp,** whose retirement has been announced. **F. J. Walliser** and **H. E. Freas** are appointed assistant traffic managers.

J. Paul Tierney, former metallurgist in the Youngstown Sheet and Tube Co.'s rod, wire and conduit plant and merchant mills at Struthers, Ohio, has been appointed assistant superintendent of the company's rod, wire and conduit plant. Mr. Tierney succeeds **John D. Anderson** who died recently.

Percy L. MacGowan has been named Chicago district engineer for Youngstown Sheet and Tube Co., East Chicago, Ind. Mr. MacGowan succeeds **H. C. Williamson** who retired some time ago.

Donald J. Shaughnessy has been appointed to the newly created position of administrative assistant — production and scheduling at the Monessen and Allenport, Pa. works of Pittsburgh Steel Co. Mr. Shaughnessy has been works accountant at Monessen. He will be succeeded in that post by **Alfred J. Lammay,** who has been assistant to works accountant.

Clarence M. (Bruno) Feehan has been appointed assistant superintendent of the open hearth department at the Monessen, Pa., works of Pittsburgh Steel Co. Mr. Feehan became a melter in 1928, a post he has held until his present promotion.

Max Jaenchen has accepted the appointment as chief consulting engineer of the Mannesmann-Meer Engineering & Construction Co. of Easton, Pa. Mr. Jaenchen will also supervise installations of Mannesmann-Meer mill machinery. Mr. Jaenchen has been a leading seamless tube mill machinery designer with Aetna Standard Engineering Co. for 26 years. Before that he had seventeen years experience in the steel and non-ferrous seamless tube industries of Europe. He began his professional career with the famous Mannesmann Tube Works of Germany, one of the parent companies of the newly formed American concern.

Ralph J. Wiethorn was named manager of the Pittsburgh, Pa., general sales office of Harbison-Walker Refractories Co. Mr. Wiethorn, who recently celebrated his 40th year with the company, has filled a number of positions in the Harbison-Walker organization. He has been serving recently as a salesman in the Pittsburgh district.

John R. Woodruff has been appointed Pacific Coast district manager of the Electric Controller & Manufacturing Co. Mr. Woodruff transferred from the Houston, Tex., office and will have headquarters at 2500 West

WILLIAM E. BOGER

SEWARD H. FRENCH, JR.

WILLIAM M. FRAME

WALTER J. PROCHAK

Sixth Street Building, Los Angeles 5, Calif. Offices under Mr. Woodruff's direction include Los Angeles, San Francisco, Seattle, Spokane, Portland, Vancouver, B. C., Edmonton, Alberta and Winnipeg, Manitoba. Succeeding Mr. Woodruff as Houston, Tex. district manager is **Claude A. Mitchell, Jr.**

William Rodgers has been elected vice president and general sales manager of Blaw-Knox Co., Pittsburgh, Pa. Mr. Rodgers joined the company on April

WILLIAM RODGERS

1, 1953 in the new staff post of general sales manager. For many years he was in the construction materials business and in recent years, prior to joining Blaw-Knox was in the motor transport field.

J. Krumhansl, treasurer of Arthur G. McKee & Co., Cleveland, Ohio will retire January 2, 1954. Mr. Krumhansl, who will continue as a director, has been treasurer and a director of the company since 1947 and has a service record of more than 40 years. **H. R. Moorhouse** was elected treasurer to succeed Mr. Krumhansl. Mr. Moorhouse has been the secretary and a director of the company for the past seven years. As assistants to Mr. Moorhouse, who will be both secretary and treasurer, the Board elected **Carl H. Ganzenmueller** and **William R. Nichols** to new positions. Effective January 2, 1954, Mr. Ganzenmueller, at present assistant treasurer, will hold the positions of assistant secretary and assistant treasurer, and Mr. Nichols, now assistant to Mr. Moorhouse, will be controller of the company.

Leroy J. Wieschaus was named district manager of the Birmingham, Ala., sales office of American Wheelabrator and Equipment Corp. Mr. Wieschaus will be located in the Farley Building.

John W. Pennington has been named manager of the new technical department of the Metal Products Division of Koppers Co., Inc., Baltimore, Md. Mr. Pennington joined Koppers in 1950 as chief engineer of the division's piston ring department and since 1952 has held the post of executive engineer for the entire Metal Products Division.

James F. Magin has been elected vice-president of the Square D Co., Milwaukee, Wis. Mr. Magin has been assigned as staff assistant to the general manager, in the special controls section.

G. N. Dow has been appointed Chicago, Ill., district sales manager, Leschen Wire Rope Division, H. K. Porter Co., Inc., St. Louis, Mo. Until his present promotion Mr. Dow had been district representative for Leschen in Detroit, Mich.

Roy J. Gavin was elected vice-president of the Irvington Varnish & Insulator Division of Minnesota Mining & Manufacturing Co. Mr. Gavin will assume his new duties immediately, and will move his headquarters from St. Paul, Minn., to the division's home offices at Irvington, N. J.

P. E. Haglund after 38 years' service with Ford Motor Co., Ecorse, Mich., has retired. At various times he was in charge of cupolas, electric furnace and open hearth departments. During his entire career at Ford he

P. E. HAGLUND

was engaged in the metallurgical field. He served as chairman of the Detroit district section of the AISE for the year 1947-1948.

A. C. Richardson, who has had supervisory charge of research in mineral processing at Battelle Institute, Columbus, Ohio, for the past twenty years, has been named technical director.

Warren C. Sprague was named factory sales and service representative for Farmers Engineering and Manufacturing Co. on the West Coast. Mr. Sprague has been associated with the Farmers firm in various sales and service positions since 1948. He will make his headquarters at Monrovia, Calif., where the firm has established a branch office.

A. D. L. Orefice was named chief engineer and **G. F. Ross** has been appointed assistant chief engineer of the coke plant department of Koppers Co., Inc., Pittsburgh, Pa. Mr. Orefice, who had been assistant chief engineer, will direct the engineering design on all chem-

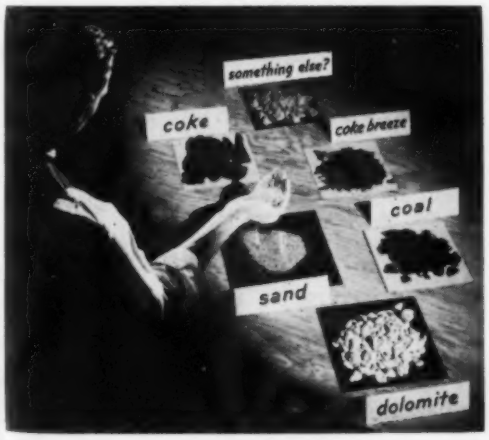
DIFFICULT BULK-HANDLING-PROCESSING PROBLEMS?

Call R&S into the picture.

It's good business, of course, to look for more effective, more economical ways to handle troublesome bulk materials — coal, coke, coke breeze, sand, dolomite and others. And it is equally good business to get R&S to help solve these familiar problems of handling, processing, storage and service.

What you get is the experience of a staff of good engineers who have been battling problems like yours for well over 50 years— an organization whose record affords solid proof that it can help you find a practical solution engineered to your needs. We can move in at any point — at the start, or to take over preliminary plans; to convert rough sketches into finished drawings, convert drawings into fabricated units, and follow through on erection — the whole job or any part of it.

How can we help? It's easy to find out. Write or phone.



ROBERTS & SCHAEFER CO.
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130 North Wells Street, Chicago 6, Ill.
HIBBING, MINN. (Box 675)
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NEW YORK 19, N. Y.
PITTSBURGH 22, PA.

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DREVER VERTICAL
STRIP ANNEALING FURNACES

. . . for ferrous or non-ferrous metals

5 important advantages

1. VERSATILITY AND FLEXIBILITY
2. ABSOLUTE UNIFORMITY OF ANNEAL
3. MINIMUM FLOOR SPACE REQUIRED
4. HIGHLY ECONOMICAL AND EFFICIENT
5. ELECTRIC OR RADIANT-TUBE-GAS-FIRED HEATED

● *Illustrated are two 1820-KW, 20,000 lbs/hr Vertical Strip Continuous Annealing Furnaces for 42" wide strip.*

Write for Bulletin No. B-61

DREVER CO.

730 E. VENANGO ST., PHILADELPHIA 34, PA.

10

ical recovery coke plant projects of Koppers Engineering and Construction Division. Mr. Ross, prior to his appointment, was manager of the electrical engineering section of the coke plant department.

Leo L. Gill has been appointed manager of the technical sales department of Harbison-Walker Refractories Co. He will maintain headquarters in the company's

LEO L. GILL

home offices in Pittsburgh, Pa. Since 1923 Mr. Gill has been employed in Harbison-Walker's engineering and technical sales departments.

Frank W. Fletcher has been named as representative in the Nashville, Tenn., area for Farrell-Cheek Steel Co. Mr. Fletcher will maintain offices at 811 Palmer Place in Nashville.

Arthur J. Whitcomb was named as sales manager of the Freyn Department of Koppers Co., Inc., Pittsburgh, Pa. In his new post, Mr. Whitcomb will be

ARTHUR J. WHITCOMB

responsible for contract sales of steel plant installations designed and built by the Freyn Department. Mr. Whitcomb has been serving as assistant sales manager of the Freyn Department since 1952.

Leroy V. Stewart has been appointed general chief clerk of the strip and tin accounting department of Youngstown Sheet and Tube Co., East Chicago, Ind. Mr. Stewart succeeds **W. G. Pocock,** retired.

Walter A. Jensen, formerly in the Buffalo, N. Y. sales office of Reliance Electric and Engineering Co., goes to San Francisco, Calif., where he will report to **Andrew C. Perrin,** the company's West Coast district sales manager. **Perry Dudley, Jr.** for the past 15 months in the Cleveland, Ohio, offices of the company, moves to Los Angeles, Calif., where he will report to **H. A. Latta,** manager of Reliance's office there. Replacing Mr. Jensen in Buffalo will be **Peter W. West,** also from the company's Cleveland headquarters.

Ben Davies has joined the research staff of Harbison-Walker Refractories Co., Pittsburgh, Pa., as a ceramic engineer. He will do research at the company's Hays Laboratory in the field of basic refractories including magnesite.

Ernest Nuber has been appointed sales manager, instrument division, of Bristol Co., Waterbury, Conn.

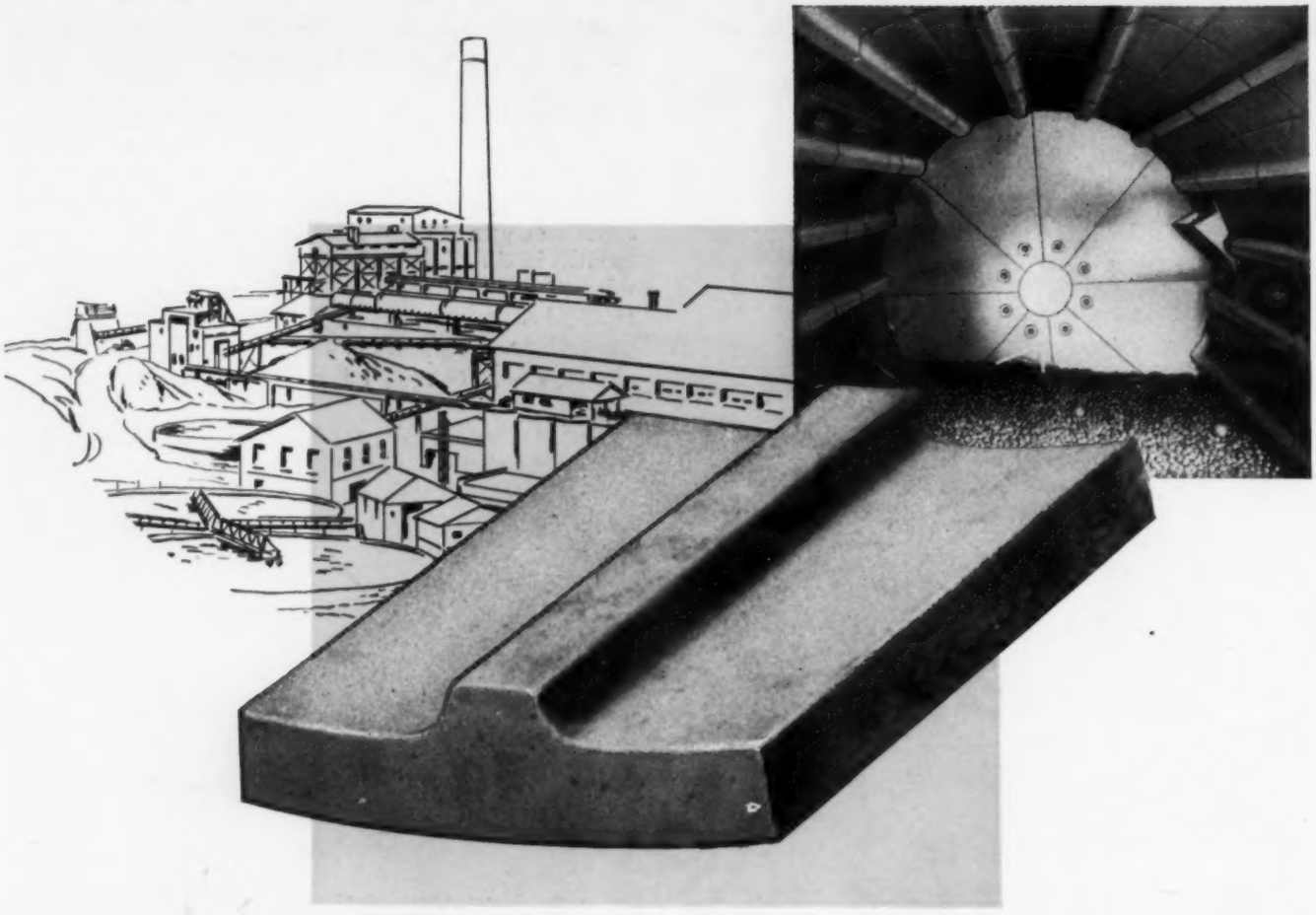
ERNEST NUBER

Mr. Nuber joined the Bristol sales engineering organization in 1929. He was made Pacific Coast manager in 1934 and later served for several years as export manager. In 1948 he was promoted to the position of manager, application engineering department. Mr. Nuber will continue to maintain his headquarters at the company's main office at Waterbury, Conn.

Karl Koehn has been named as Pennsylvania representative of Commercial Contracting Corp., Detroit, Mich. Since coming to this country in 1922 from his birthplace, Duisburg, Germany, Mr. Koehn has resided in Pittsburgh, Pa. He has been employed by such well-known firms as Mesta Machine Co., Taylor & Wilson, Fisher Body Division, G-E, G. M. C. and Pittsburgh Engineering Co.

George P. Wilson, Jr., former manager of the control section, has been named manager of the finance department of the Engineering and Construction Division of Koppers Co., Inc., Pittsburgh, Pa. **Herbert A.**

(*Please turn to page 192*)



this LINER boosted production 35%

AMSCO Ball Mill Liners

Reduced Down-Time, Increased Production...

A large West Coast cement producer found that Ball Mill Liners were causing expensive trouble. Liners were thick—*over 3 inches.* This meant reduction in mill capacity. Thick liners also meant tremendous weight. Both thickness and weight reduced production and efficiency. *Liners wore rapidly,* too, causing frequent, expensive replacement jobs, with costly labor and material. And added to the bill was lost production due to mill down-time.

Well-known for their skill in handling impact and abrasion-resistant alloys, AMSCO engineers and foundrymen were consulted.

AMSCO solved the Ball Mill Liner problem.

AMSCO designed a new, light, thin—*1 inch thick*—liner, which because of lightness and thinness increased mill capacity, heightened efficiency. The new liners lasted beyond all expectations and in addition the segments were easier to install. These factors, plus reduced replacement down-time, have been responsible for a *35% increase in production.*

AMSCO is the largest producer of Manganese Steel, "the toughest steel known," which has proven itself under countless abrasion and impact situations. And where the service conditions require it, AMSCO also produces Chromium-Molybdenum and Chrome-Manganese alloys.

If you have a tough wear problem and suspect that there may be a better alloy for your purpose, you are invited to write to AMSCO for further information.

AMERICAN Brake Shoe COMPANY

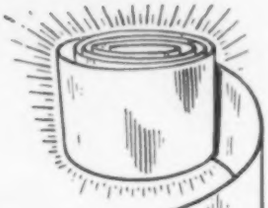
AMERICAN MANGANESE STEEL DIVISION

411 EAST 14th STREET • CHICAGO HEIGHTS, ILL.

Other Plants: New Castle, Del., Denver, Oakland, Cal., Los Angeles, St. Louis. In Canada: Joliette Steel Division, Joliette, Que.
Amsco Welding Products distributed in Canada by Canadian Liquid Air Co., Ltd.

Galvanizing
Aluminizing
Bright Annealing and
Normalizing Strip ------ Continuously

Strip in single or multiple strands up to a total width of 54" may be bright annealed or normalized, continuously, in this EF gas fired radiant tube installation. Capacity 7200 lbs per hour.

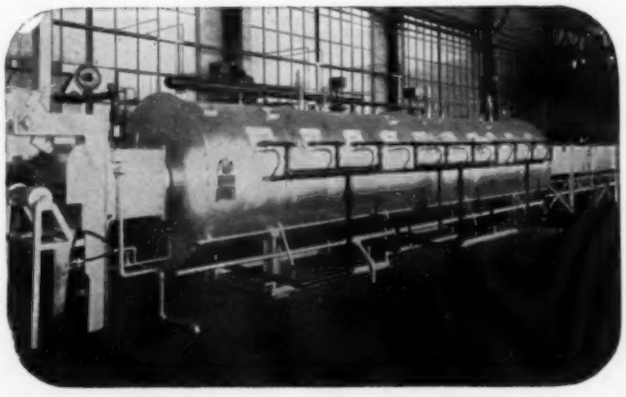


A large capacity continuous strip normalizing, annealing and galvanizing unit. This is a combination EF gas fired radiant tube and electrically heated installation and is over 400 feet long.

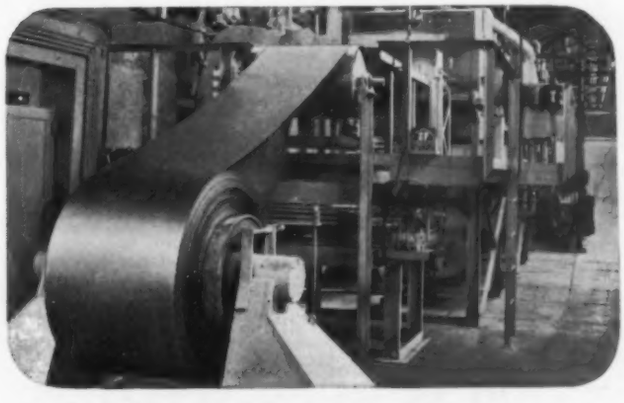
We are in position to design, build and put in operation; continuous strip lines for hot or cold rolled, high or low carbon, stainless, silicon, tinplate, aluminum, brass, bronze or any other ferrous or non-ferrous strip — for bright annealing, normalizing, galvanizing, aluminizing, tinning or any other process — in the size and type best suited to your plant, process, product or production requirements. No job is too large or too unusual.

Put your production furnace problems up to experienced engineers — *it pays.*

THE ELECTRIC FURNACE CO.
Salem, Ohio
EF **Gas Fired, Oil Fired and Electric Furnaces**
Canadian Associates • CANEFCO LIMITED • Toronto 1, Canada



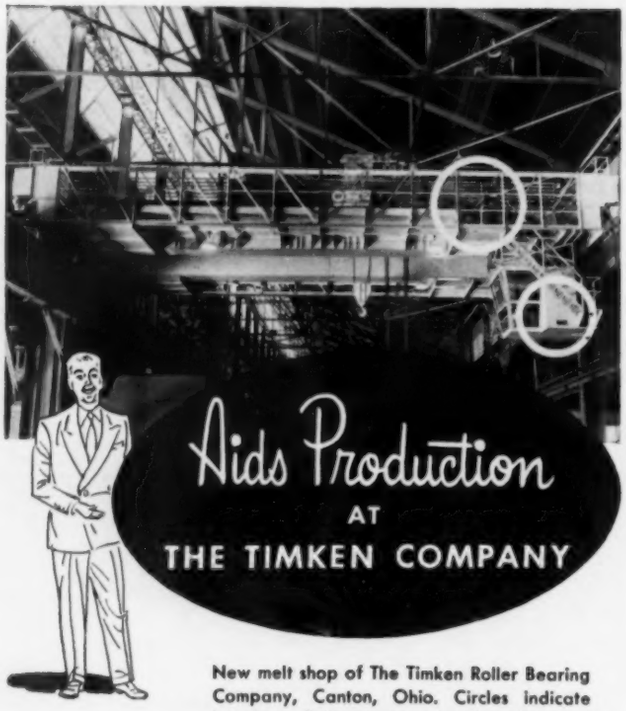
Stainless steel strip is bright or process annealed, continuously, in this EF gas fired special atmosphere tube muffle type furnace. It also handles other strip requiring lower temperatures.



An EF special atmosphere furnace with flame preheating burn-off or oxidizing section and controlled heating and cooling zones for producing various surface conditions on strip.

LINTERN

AIRE-RECTIFIER



New melt shop of The Timken Roller Bearing Company, Canton, Ohio. Circles indicate location of the Lintern Aire-Rectifier—the Condenser on the crane and Cab Unit in the cab. These two units, connected by refrigerant lines, assure comfortable, healthful working conditions in the cab.

This air-conditioning equipment provides the protection so essential for the crane operator working directly over the severe flash heat of top charging electric furnaces. He can operate his crane efficiently in a comfortable, dust-free cab.

The installation is our latest model split system — the large unit Model 501 AC-27. It handles 720 cfm at a temperature of 52-57° F. off the cooling coil. The condenser unit is located on the crane high above the source of radiant heat. The cooling coil and filters are located in an easily accessible cabinet within the insulated cab, completely protected from mill heat and dirt. Two relatively small refrigerant lines connect the two units. Because of their little exposed surfaces, there is practically no loss in efficiency.

If you have a condition where heat, fumes and dust interfere with production, we would appreciate the opportunity of explaining what you could save with a Lintern Aire-Rectifier.

THE LINTERN CORPORATION

ROUTE 20, EAST • PAINESVILLE, OHIO

(Continued from page 189)

Semler, former control manager for the division's Freyn Department, has assumed broader responsibilities as manager of the control section for the entire Engineering and Construction Division. Mr. Wilson rejoined Koppers early in 1953 after a two year leave of absence during which he served as director of the coke division of the Solid Fuels Administration in the United States Department of Interior. After joining Koppers in 1948 as assistant manager of the finance section of the Engineering and Construction Division, Mr. Semler took the post as control manager of the division's Freyn Department in 1951.

Steve Cidylo has been advanced to chief draftsman in the Chicago district plants of Youngstown Sheet and Tube Co., East Chicago, Ind.

Robert L. Stockus has joined Farrel-Birmingham Co., Inc., as assistant manager of the company's rolling

ROBERT L. STOCKUS

mill division. Prior to this appointment, Mr. Stockus was sales manager of Armzen Co., Waterbury, Conn.

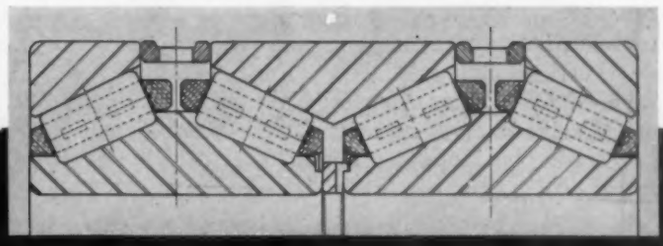
Dr. James F. Eversole has been named vice-president in charge of research for Bakelite Co., a division of Union Carbide and Carbon Corp., New York, N. Y. Since 1951, Dr. Eversole has been serving as manager of research administration of Union Carbide and Carbon Corp.

Alfred Halliday has been named representative for C. B. Hunt and Son, Inc. Mr. Halliday has offices at 317 Starks Building, Louisville, Ky; 1509 Madison Avenue, Memphis, Tenn.; and 916½ Henley Avenue, Knoxville, Tenn.

A. G. Parks was appointed assistant vice president for industrial relations at Weirton Steel Co., Weirton, W. Va. **Edward A. Ross** was appointed manager of industrial relations, with duties covering all divisions of that department. Since 1943 Mr. Parks was made manager of payrolls for the company and eight years later was appointed administrator of wage rates, the

TORRINGTON BEARINGS AT WORK

TORRINGTON Four-Row Tapered Roller Bearings on finishing-stand work-rolls of U. S. Steel 80" hot-strip mill were specially designed for high thrust loads.



Rolling to a new world's record!

2,621,500 net tons of 2000-foot coils of uniform strip! That was the world's record rolled in 1951 by U. S. Steel's 80" hot-strip mill—on TORRINGTON Tapered Roller Bearings.

Precision-ground TORRINGTON Tapered Roller Bearings are used on many of the work-roll and back-up thrust positions, from the huge mill's No. 1 scale breaker to its finishing stands.

These TORRINGTON Bearings, say U. S. Steel engineers, have given excellent service. Specially designed by TORRINGTON to withstand the high thrust loads developed, they have helped to cut down-time to only one hour a turn.

Get more tons per turn from *your* mills. Equip them with TORRINGTON Tapered Roller Bearings.

THE TORRINGTON COMPANY

South Bend 21, Ind. Torrington, Conn.

TORRINGTON TAPERED ROLLER **BEARINGS**

Spherical Roller • Needle • Tapered Roller • Straight Roller • Ball • Needle Rollers

position he held prior to his current appointment. Mr. Ross was appointed manager of labor relations in 1951 and was serving in that important capacity at the time of his present appointment.

Everett W. Lundy has been named assistant sales manager, Peerless Pump Division, Food Machinery and Chemical Corp., Los Angeles, Calif. Mr. Lundy, previously Pacific district manager for the pump firm, will be succeeded by **Robert H. Hull,** presently Peerless' central district manager at Indianapolis, Ind. Mr. Hull, in turn, will be succeeded by **Waldo T. Harman,** Peerless' Chicago, Ill., branch office manager.

G. T. Collatz has been named representative to handle the sale of American Flexible Coupling Co. products in its New England territory, with offices at 473 Washington Street, Wellesley, Mass. Mr. Collatz

G. T. COLLATZ

was formerly associated with Cleveland Worm & Gear Co. and with the Farval Corp.

Carl A. Swanson is now assistant Chicago, Ill., district engineer for Youngstown Sheet and Tube Co. Mr. Swanson has been a member of the company since 1947.

John S. Carr has been appointed manager of pump sales for American Manganese Steel Division of American Brake Shoe Co. Formerly a sales engineer, he has been with the company since 1949. He will be located at the Amsco plant in Chicago Heights, Ill.

William R. Frey has been retained as representative for Protective Coatings, Inc. in Denver, Colo. and Salt Lake City, Utah.

Calvin J. Timmins has joined the sales force of J. Alex Gordon and Co., Detroit, Mich., representative of the Automatic Transportation Co. Mr. Timmins was formerly a salesman for Contractors Machinery Co., Detroit.

James W. Cameron has been made works engineer for the Maple Grove, Ohio, quarrying and burning plant operations of Basic Refractories, Inc.

Dr. Raymond W. McNamee was named manager of research administration of Union Carbide and Carbon Corp., New York, N. Y.

W. J. Sonnenburg has been appointed Detroit, Mich., district manager of the Electric Controller & Manufacturing Co. to succeed **E. F. Vidro** who has retired after 40 years service. Mr. Sonnenburg has been a member for several years, of the Detroit sales office which is located in the Dime Bank Building.

J. A. Ritt has been appointed field sales representative in the newly-opened Duluth, Minn., sales office of Reliance Electric and Engineering Co. The new sales office will be located in the Christie Building.

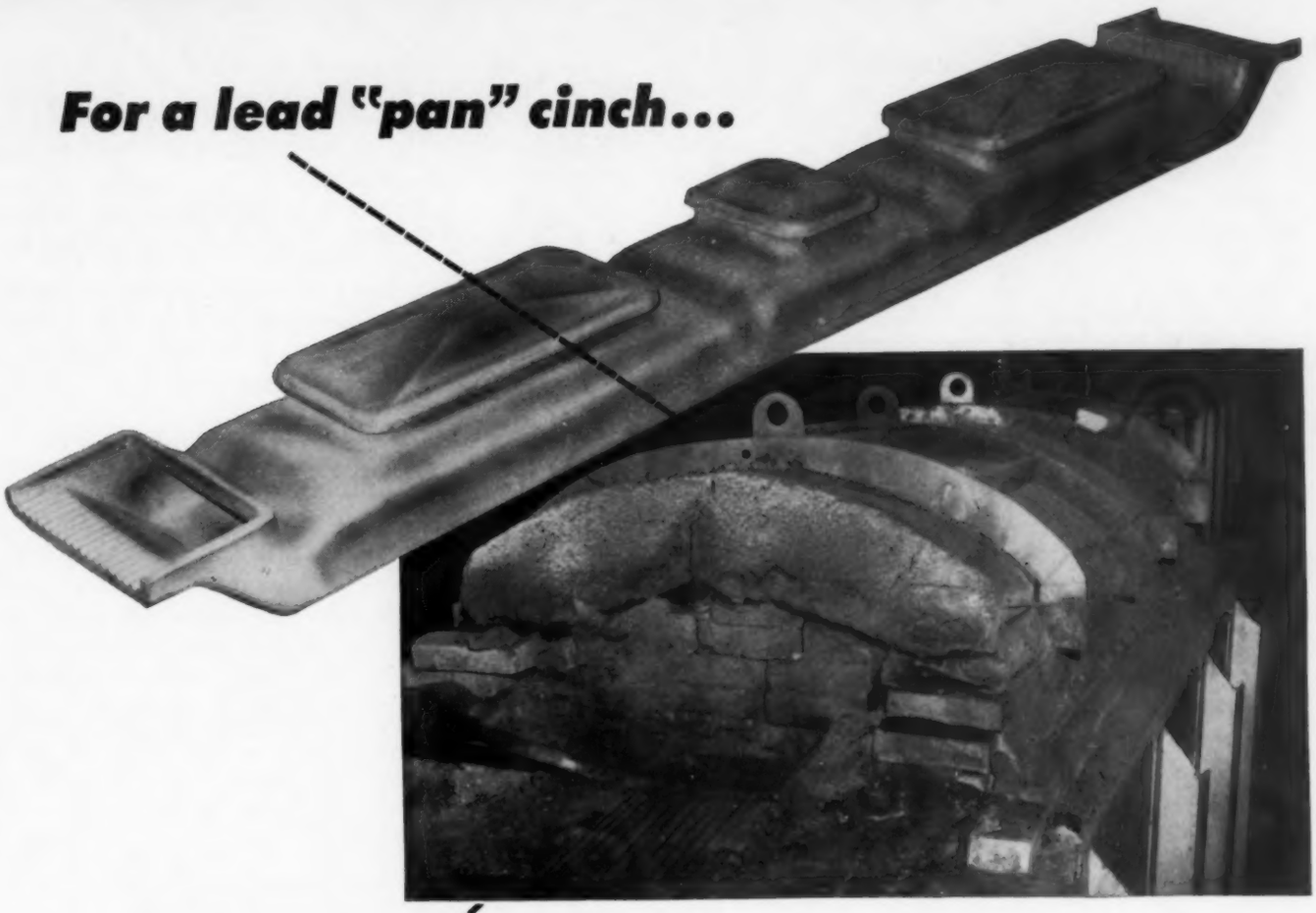
E. Austin Scholin has been appointed representative in Ohio for Kaydon Engineering Corp., Muskegon, Mich. Mr. Scholin will headquarter at 3769 East 145th St., Cleveland, Ohio.

Walter C. Thompson, formerly vice-president in charge of sales, has become executive vice-president of Torrington Co., Torrington, Conn., to succeed **Alfred W. Burg,** who has retired after 37 years with the company. **Ray B. Nichols,** formerly president and general manager of Torrington Co. of Indiana, South Bend, Ind., a subsidiary, has been made vice-president in charge of sales, succeeding Mr. Thompson. Mr. Nichols, who will make his headquarters at Torrington, Conn.,

RAY B. NICHOLS

also continues as president of the Indiana company. **Rodney T. Dunlap,** formerly assistant general manager of the Torrington Co. of Indiana, has been named vice-president and general manager of this division. Other promotions at the South Bend plant include chief engineer **John A. Toth,** who has been promoted to assistant general manager, and **Walter Fisher,** formerly assistant chief engineer, who becomes chief engineer.

For a lead "pan" cinch...



it's THERMALLOY* to outlast cast iron by 479 days!

A large steel and wire company uses a double-lead patenting furnace to give good drawing qualities to wire. In this process, wire is drawn through a "lead" pan enclosed in the furnace where temperatures range from 1600 to 1650°F.

Previously, cast iron "lead" pans were used . . . and the furnace had to shut down nearly every 21 days because the pan burned out and needed replacement. Then, a Thermalloy "lead" pan with integrally cast sinkers was installed. *To date, this pan has over 500 days of service . . .* saving this company expensive hours of repair and down time.

This is just one example of how a Thermalloy heat-resistant casting has helped a manufacturer to realize more economy in heat-treating parts. Do you have a similar need for Thermalloy in retorts, furnace parts, trays, racks, pots or muffles? Call in an Electro-Alloys engineer for full information, or write Electro-Alloys Division, 4007 Taylor Street, Elyria, Ohio.

THERMALLOY "LEAD" PAN ADVANTAGES

- Resists air-line attack, scaling and oxidation.
- Higher strength prevents sagging and distortion.
- Less weight means easier installation and less maintenance of supporting arches.
- Greater resistance to abrasion.

*Reg. U. S. Pat. Off.

AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION
ELYRIA, OHIO

Phillip B. Weaver has been appointed assistant to the general sales manager of Harbison-Walker Refractories Co., Pittsburgh, Pa. Mr. Weaver joined the company in 1916 as an assistant correspondent. Later he served as correspondent, chief correspondent, and in 1926 assumed the office of chief clerk in the sales department.

E. J. Conlan was named district manager for Kennametal, Inc. in their newly established southern sales district. Headquarters office of the new district is at 70 Fourth Street, N.W., Atlanta, Ga. Appointments in other district offices have also been announced by Kennametal, Inc., as follows: **Walter Henry** and **Frank Minion** as representatives in the Cleveland, Ohio, district office, and **Andrew Horvath** as a representative in the Philadelphia, Pa., office. Service engineers have been added to Kennametal's district office staffs as follows: **Gerald J. Kelley** in Detroit, Mich., **James R. Morgan** in Cleveland, and **Albert L. Morshauser** in Cincinnati, Ohio.

Obituaries

J. E. Paul, 63, Philadelphia, Pa., district manager of Sharples Corp., died September 1. Mr. Paul had been associated with Sharples Corp. for the past 29 years.

Henry W. Bartling, 60, application engineer in charge of the metal industries group of Allis-Chalmers motor and generator section and well known throughout the steel industry, died August 21 in Milwaukee, Wis. Mr. Bartling joined Allis-Chalmers in 1914 after graduating as an electrical engineer from the University of Illinois. He was employed successively in the company's Detroit, Mich., Cleveland, Ohio, and Pittsburgh, Pa., offices as a sales representative before transferring to the motor and generator section at West Allis.

John W. Sheperdson, 74, who recently retired as executive vice president of Morgan Construction Co., Worcester, Mass., died October 1. Prior to his going with Morgan in 1916, Mr. Sheperdson had served as steam engineer for the former Cambria Steel Co., Johnstown, Pa. (now Bethlehem Steel); as superintendent of Gautier works of Bethlehem; and assistant general superintendent and chief engineer of Central Iron and Steel Co., Harrisburg, Pa.

John O. Larson, 39, director and executive vice-president of Fischer & Porter Co., Hatboro, Pa., died September 18.

Advance Orders Now Being Taken for

Tube Mill Practice

A collection of articles from the IRON AND STEEL ENGINEER on various phases of tube making.

Practical information on layout and operation of facilities for seamless, butt and electric weld pipe, a field in which little information has been published . . . 23 articles by 20 authoritative writers . . . invaluable for engineers, operators, trainees and students.

8-¼ x 11-¼ in.,.....196 pages, illustrated, clothbound

Price: To AISE Members . . . $2.00
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ASSOCIATION OF IRON AND STEEL ENGINEERS

1010 Empire Building

Pittsburgh (22), Pa.

Need an oil seal that's ideal for FLEXIBLE operation?...

Exhaustive tests by Ajax Flexible Coupling Co. showed that Clipper Seals met all 10 of these exacting requirements

THIS NEW AJAX DIHEDRAL COUPLING handles misalignment, hitherto considered impossible, between driving and driven machines. Because of its unusual design features, it was necessary for Ajax engineers to anticipate and set up rigorous qualifications for the oil seal that would safeguard the lubricants in the coupling. Clipper Seals were selected because they fulfilled *all ten* of the following *requirements:*

1. **A tight fit** on each gear hub, and proper contact with the inside diameter of housing.

2. **The ability** to stand up under constant flexing over a wide range of speeds.

3. **Sliding contact** with hub to allow free end float.

4. **Absolute retention** of lubricant to protect gear teeth.

5. **The dual function** of keeping the dirt out and the fluid grease in.

6. **Long life** to equal the long life of the coupling under severe conditions.

7. **Ability to withstand** normal running as well as increased ambient temperatures encountered in steel mills, foundries and processing plants.

8. **Performance unaffected** by operation in corrosive atmospheres, and by hosing down with water.

9. **A range of sizes** to meet the required sizes of the manufacturer.

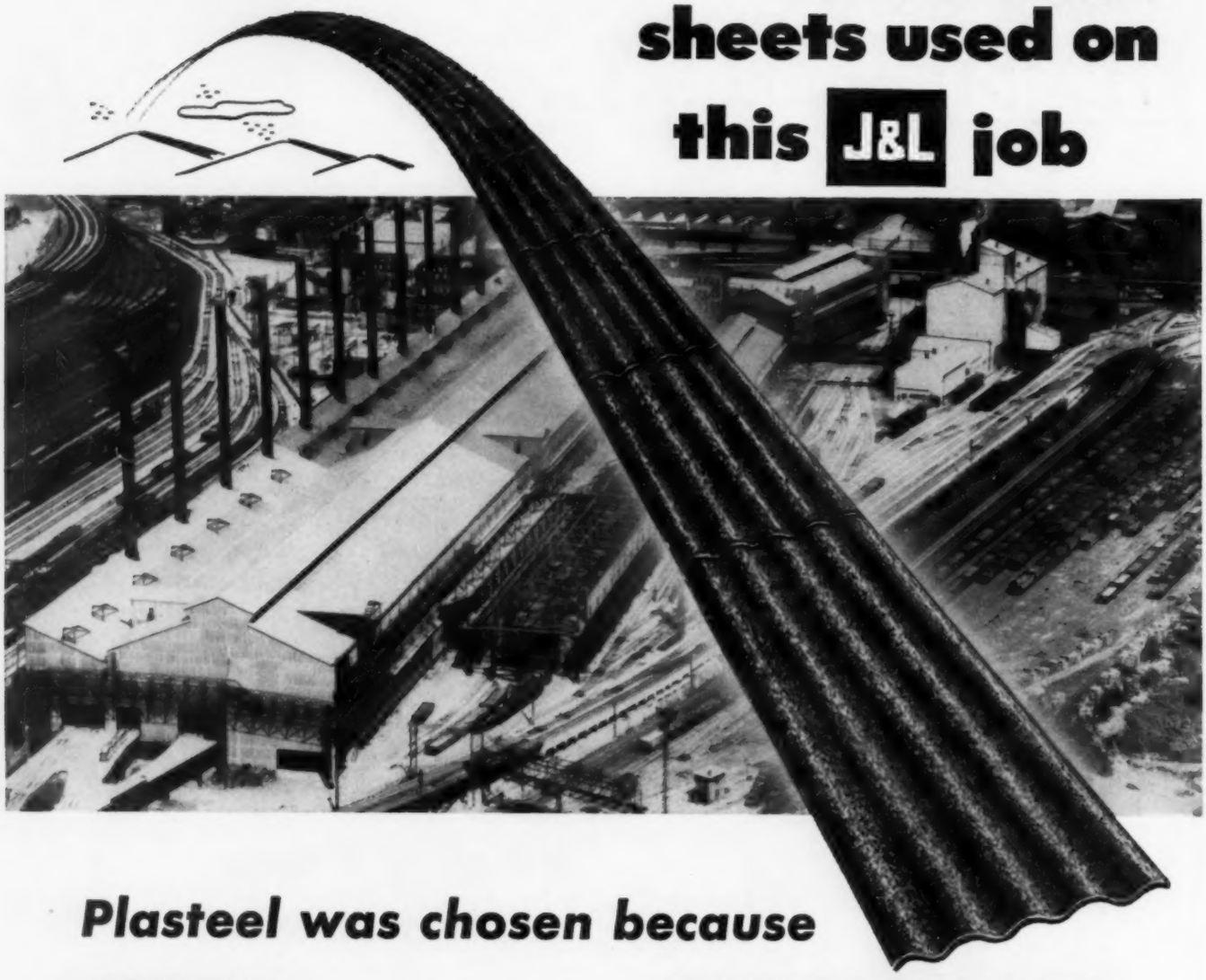
10. **Convenience** of assembly and disassembly in the field.

Clipper Seals, day after day, are meeting new and arduous requirements set up by design engineers in almost every field. Their wide variety of compact designs, their precision moulding, and ease of installation have given them a high preference rating for almost any sealing condition on all types of equipment. For further details, address Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

JOHNS MANVILLE JM PRODUCTS

Johns-Manville CLIPPER SEALS

40 miles of Plasteel sheets used on this J&L job



Plasteel was chosen because

MICA makes the DIFFERENCE

40 miles of *Plasteel* sheets—33" wide is a lot of roofing and siding. That, to the plant engineer, is 635,000 square feet of maintenance-free building protection. Only *Plasteel* gives you the advantages of Mica . . . and Mica makes a big difference! The Mica topping reflects the sun's rays and prevents the drying out of the volatile oils in *Plasteel's* asphalt-plastic coating. Mica prevents deterioration and practically eliminates maintenance costs. It provides a tough wearing surface, and gives *Plasteel* a pleasing finish. That's why more industrial building projects specify *Plasteel* today.

If you are planning new buildings, mail PLASTEEL Coupon today.*

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Fairfield Tin Plate Mill
Fairfield, Ala.

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Ford Motor Co.
Steel Division
Dearborn, Mich.

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JOHN LEROY HELLMAN
Engineer
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Sparrows Point, Baltimore, Md.

WILLIAM P. HERBERT
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Rotary Electric Steel Co.
Detroit, Mich.

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Columbia-Geneva Steel Division
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United States Steel Corp.
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CARTER KENDALL
Chief Safety Engineer
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Bethlehem, Pa.

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Associate

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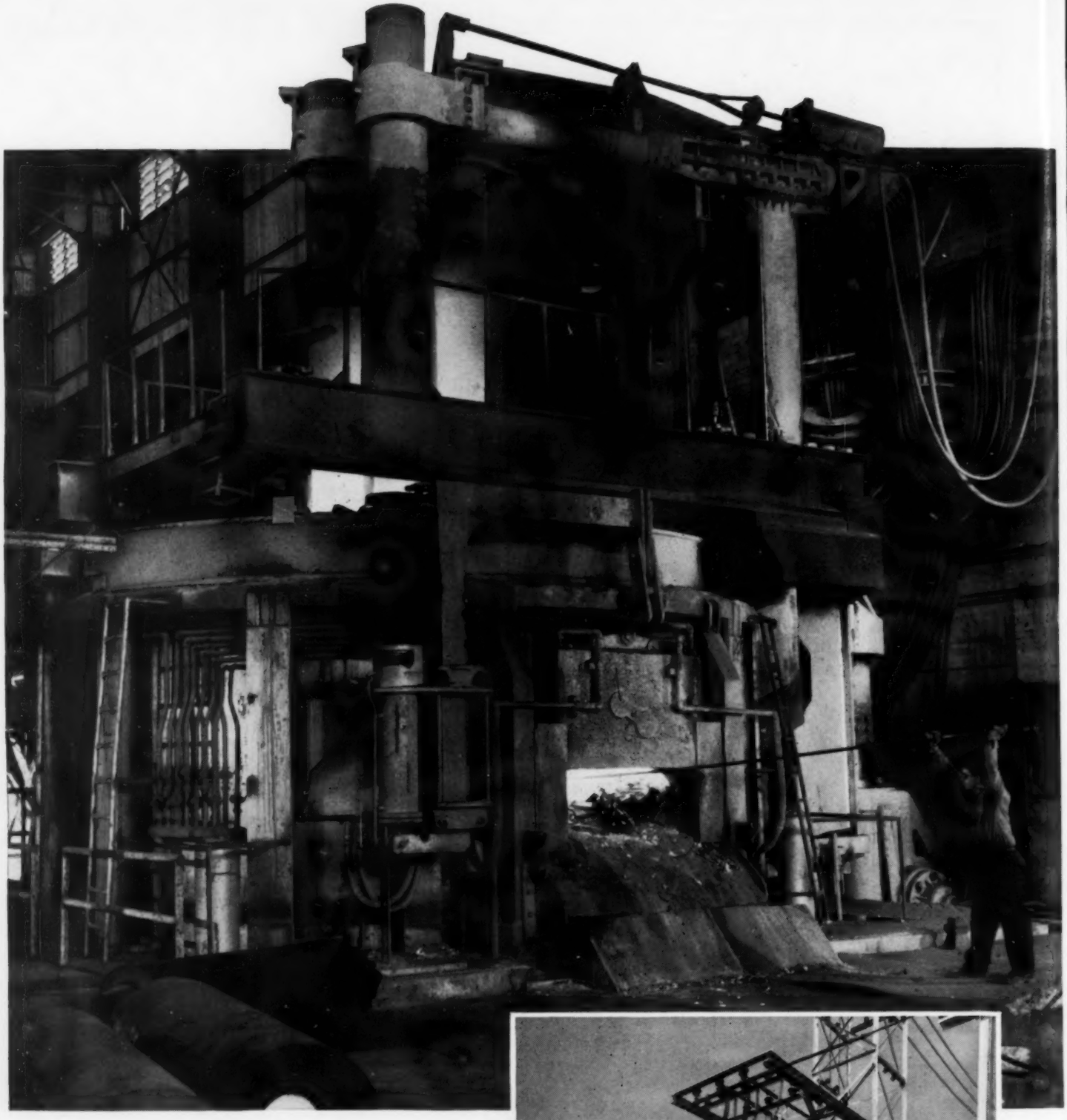
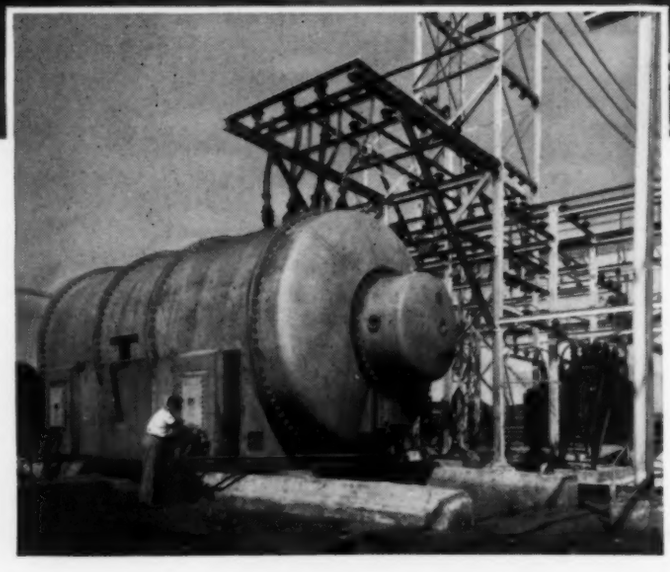
Pittsburgh, Pa.

Junior

MARSHALL H. LANG
Engineering Trainee
United States Steel Corp.
Pittsburgh, Pa.





This Northwestern Steel & Wire Company furnace, at Sterling, Illinois, is the largest arc furnace in service in the world. The first of three such furnaces being installed here, it's expertly controlled by Westinghouse Rototrol.

Northwestern's new 60/70,000 kva synchronous condenser, built by Westinghouse, has helped increase the power system's stability and has eliminated light flicker.

Westinghouse package boosts furnace output, cuts power costs

Largest arc furnace in the world . . . or the smallest . . . no matter what size you're planning, a Westinghouse power-package, backed up by Westinghouse engineering help, will make your furnace production figures glow.

Engineering help

Westinghouse engineers will help you plan a complete, one-package electrical installation, including a power supply setup that can handle tremendous loads. Look, for example, at the new Westinghouse synchronous condenser, pictured at the lower left. Installed at Northwestern Steel and Wire Company for the world's largest arc furnace, this unit absorbs peak power requirements and minimizes disturbances to the electrical system.

Two electrical brains

Westinghouse Rototrol® maintains desired power input by quickly, accurately and automatically adjusting the electrode position, according to changing furnace demands. Optimelt®, another Westinghouse development, can provide even more precise control by automatically determining the best kw input.

First with the finest

To withstand the power surge when the furnace electrode touches the charge, Westinghouse supplies a shell-form transformer . . . far stronger than other types of construction. Also, Westinghouse has developed new hard-working air-blast circuit breakers. These provide 500 kva interrupting capacity for furnaces up to 1200-2000 amperes. Imaginative engineering like this helps explain why more Westinghouse furnace equipment is in use than all other makes combined.

Booklet of ideas

A free 20-page booklet, *Westinghouse Equipment for Arc Furnaces,* can spark ideas for your operation. Here's convincing evidence . . . facts, installation photos, technical data . . . to show that it's wise, when your next project comes up, to call Westinghouse before planning begins. Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania. J-94984

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NEW DRAVO LIGHT-WEIGHT MAN TROLLEY INSTALLATION BROUGHT THESE RESULTS AT PITTSBURGH COKE & CHEMICAL . . .

	NEW TROLLEY	OLD TROLLEY
Bucket Ore Load	8½ tons	5 tons
Operating Cycle	50 seconds	60 seconds
Free-digging Tonnage	600 tons/hr.	300 tons/hr.

Early in 1952, engineers at Pittsburgh Coke & Chemical Company foresaw a materials-handling problem which would arise when a new blast furnace was added to the plant's facilities. The existing materials-handling bridge would be unable to keep up with expanded operations when the new furnace began functioning. Dravo engineers were called in to discuss the problem.

The result was a decision to install a new Dravo light-weight man trolley which would permit using a larger bucket. This increased the bridge's capacity at ⅛ the cost of a new bridge. Installation time was only 13 hours. Here is how it was done.

1 Designed and constructed by Dravo Corporation, the new man trolley was blocked on cribbing below the bridge. Each axle was lifted 75 ft. to the trolley runway.

2 Both axles were left suspended above the runway until the trolley frame with its attached machinery house and operator's cab was hoisted, placed on runway rails and supported with the trolley jacking lugs.

3 The trolley frame was hoisted into place by steam-driven block-and-tackle. The trolley's all-welded construction with liberal amounts of aluminum used in the machinery house and operators' cab greatly reduced its weight.

4 It took only 13 hours to install the new trolley and remove the old one. With the short time the bridge was out of service, production of the two blast furnaces at the plant was not interrupted.

The installation of a Dravo light-weight man trolley on existing materials handling structures still in good structural condition is the practical way to increase the capacity of ore and coal bridges to meet growing production requirements.

The weight saving factors of the new trolley are utilized in a larger capacity bucket without increasing the over-all load on the bridge. Some of the weight-saving factors include: All-welded frame of corrosion-resistant alloy steel, an aluminum sheathed machinery house and operator's cab, heat treated axles and the use of high-strength alloy components elsewhere.

A new Dravo light-weight man trolley can step up your bridge performance. If you have a materials-handling problem, we will be glad to discuss it with you and suggest a logical solution.

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DESIGNERS and BUILDERS

Bridges and Unloaders • Tower-type Unloaders
Whirler Cranes • Floating Cranes
Dravo Rail Clamps • Barge Shifters
Modernized Trolleys for Existing Bridges

Equipment News...

NEW LUBRICANT

▲ Three years of rigid testing and application under all industrial and automotive conditions mark "Plastilube" as one of the greatest advances in multi-purpose lubrication in the past twenty years. The new lubricant, which replaces and outperforms grease in hundreds of industrial and automotive functions, was developed by engineers of Warren Refining and Chemical Co. to solve the problems of grease breakdown under extreme conditions.

Engineer checks heat resistance of "Plastilube" with a blowtorch. Hailed as a successor to grease, the new lubricant will not melt or freeze, will not break down, and retains its pumpability at low temperatures.

This "successor to grease" is a stable chemical compound without a soap base. For this reason its adaptability under almost any stress or temperature gives it a marked superiority over grease. The lubricant will not break down and will neither melt nor freeze. The lubricant displays excellent adhesiveness in boiling water and retains its pumpability at low temperatures.

This lubricant, performing all the functions of grease without any of the limitations of grease, has filled an important need long sought by lubrication engineers. Indications are that its possibilities for longer wear and efficient performance are unlimited.

Although the main use of this lubricant is for lubrication of bearings where temperatures vary from below freezing to more than 500 F, it is adaptable to virtually every automotive and industrial use.

This lubricant has filled a long-standing need for a stable lubricant for use in centralized systems. A knotty problem confronting manufacturers and owners of centralized systems has been lubricant breakdown or separation in the orifices, lines and valves. Such separation, inherent in soap base grease under high pressures, clogs these parts. The result is frequent equipment shutdown and costly maintenance time wasted to keep the lubricant moving to the bearings as needed.

Several owners of centralized systems have reported that the lubricant has been used continuously since it was first marketed over three years ago, without a minute's loss in maintenance time because of clogging or separating of the lube.

Warren engineers have also developed a new lubricant for open gears bearing the name "Plastigear." It furnishes far more effective lubrication results than the conventional asphalt residuum base lubricants. It has greater adhesive properties and a higher melting point than other lubes that require melting or cutting with solvents before application. It is manufactured in a consistency that can be applied cold by hand or by peddle. It will not peel off when operating at high temperatures and can be used successfully outdoors under any climatic conditions. Consumption is reduced and cleanliness assured by the elimination of "slinging" of the lube.

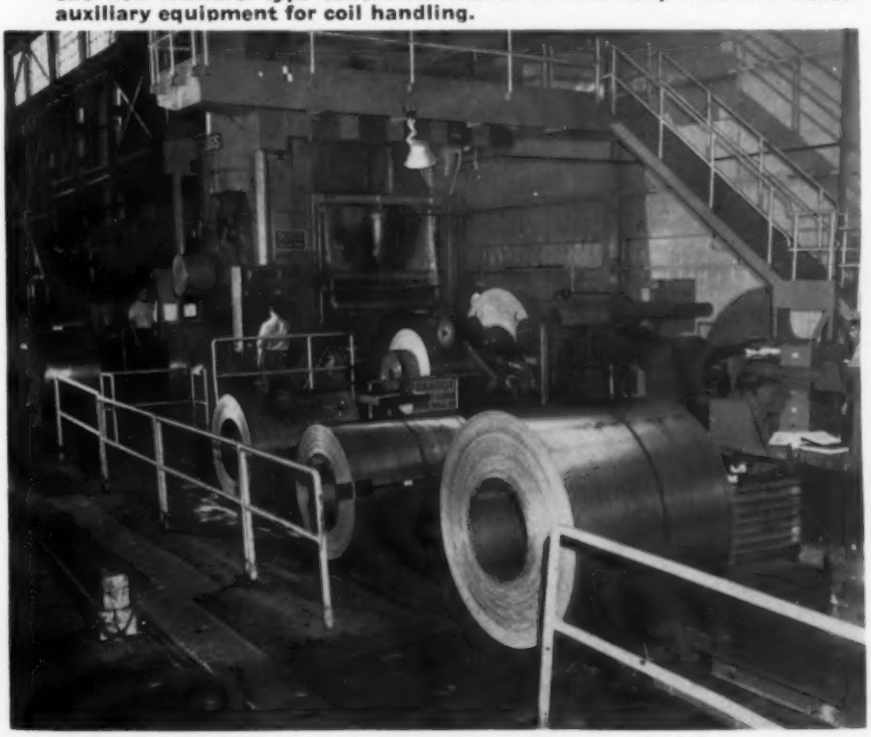
STORAGE BATTERIES

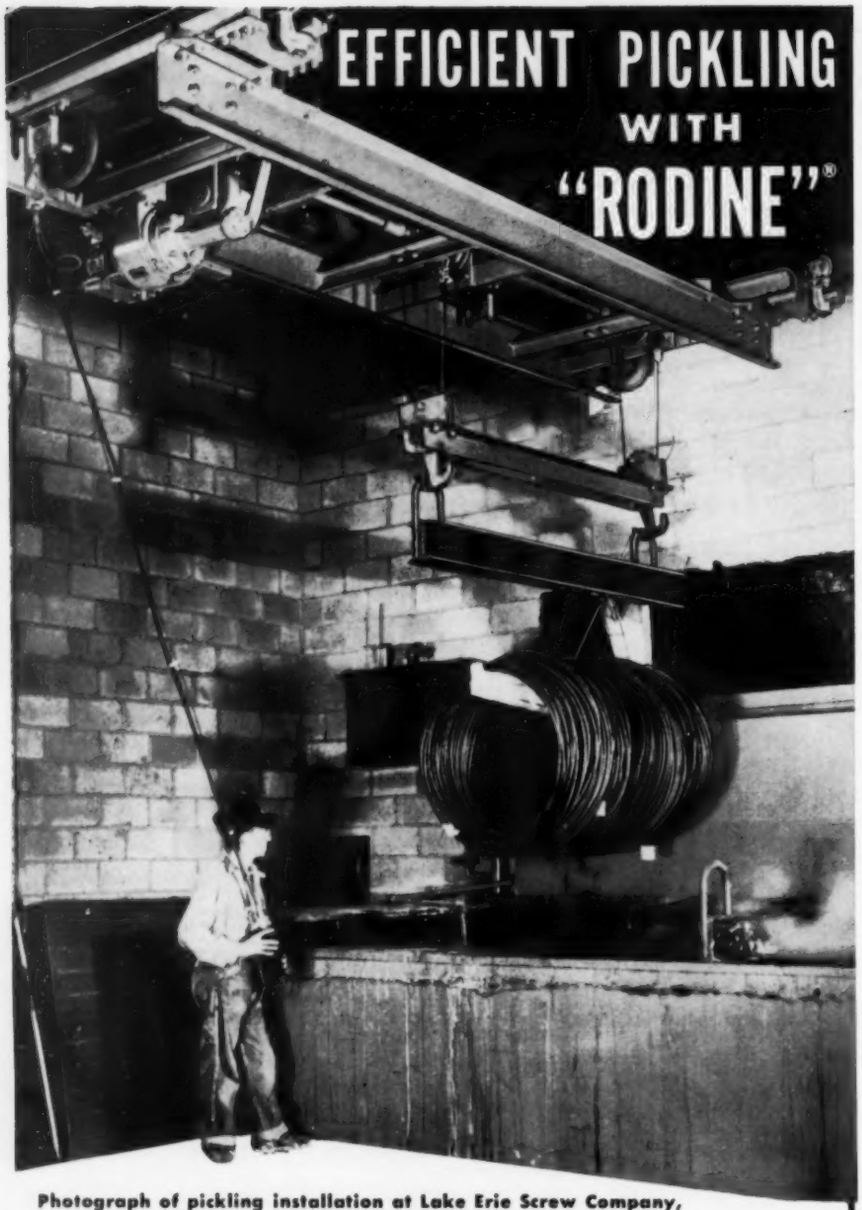
▲ Nickel cadmium storage batteries, the manufacture and marketing of which were pioneered in the United States by the Nickel Cadmium Battery Corp., in 1945, have during the past eight years gained wide acceptance in the steel industry.

The use of steel for their plate structure, posts and cell containers,

NEW TEMPER MILL FOR RIVER ROUGE

This new four-high temper mill 21 in. and 53 in. x 66 in. with complete, modern, heavy coil handling equipment was designed and built by E. W. Bliss Co. for Ford Motor Co.'s Rouge plant in Dearborn, Mich. It is part of a modernization of steel plant facilities at Ford which also included two new mandrel-type coilers for the 66 in. hot strip mill and other auxiliary equipment for coil handling.





Photograph of pickling installation at Lake Erie Screw Company, by courtesy of The American Monorail Company, Cleveland, Ohio.

Rod and wire are pickled clean in "Rodine"-inhibited acid without waste of either acid or metal. Breakage in drawing, from acid brittleness, is minimized.

Wire and rod, pickled with "Rodine", as compared with less effective inhibition, are larger in diameter, and when drawn to the finished gauge the coils are longer and correspondingly heavier.

"Rodine" more than pays for itself in savings of acid and metal.

AMERICAN CHEMICAL PAINT COMPANY

CHEMICALS ACP PROCESSES

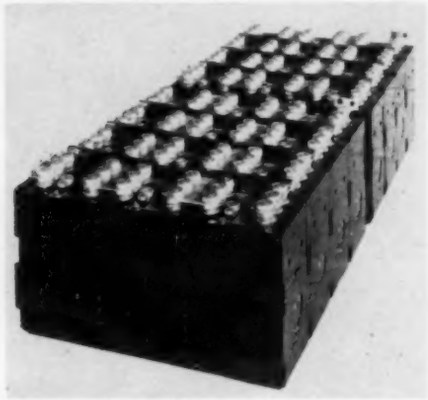
General Offices:

AMBLER, PENNSYLVANIA

Detroit, Mich. *Niles, Calif.* *Windsor, Ont.*

along with an alkaline electrolyte, make "Nicad" batteries a reliable source of standby power in steel mills, chemical and industrial plants. Circuit breaker closing, switch tripping, emergency lighting, alarms, stationary engine starting and diesel locomotive cranking are among their principal applications.

Low overall annual operating costs reported by users of these batteries result from their long-life, ability to withstand mechanical and electrical

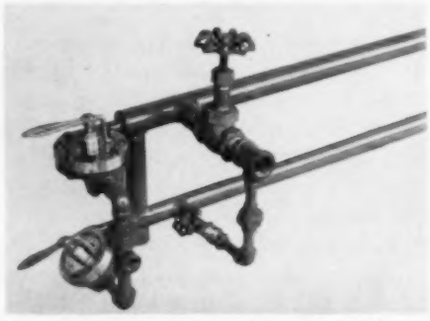


abuse and simplicity of maintenance. They do not give off corrosive fumes, do not require special charging procedures or specific gravity records and may, when operations are closed down temporarily, be left in any state of charge without attention or fear of deterioration.

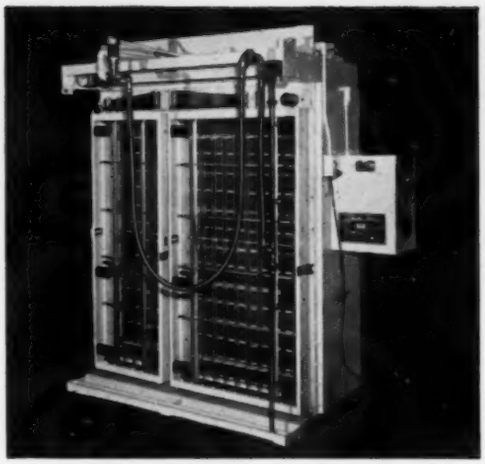
In addition to their use in steel plants, these batteries are filling important roles in pipeline operations, government, telephone, marine and railroad services.

OIL BURNER UNIT

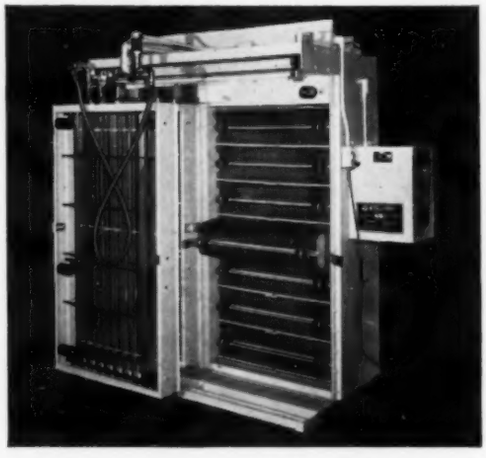
▲ For the initial heating of hot blast stoves in a new steel plant where gas was not available for the first start-up, the Hauck Manufacturing Co. developed and supplied an oil burner unit



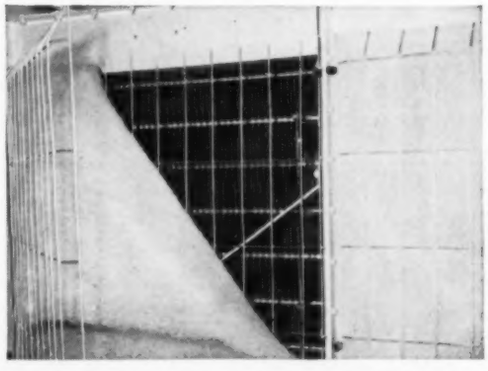
shown in the illustration. It produces a long, cylindrical pattern and luminous flame, and is easily adjustable in firing capacity and flame intensity. After the smaller capacity, oil burning pilot burner with the conical metal



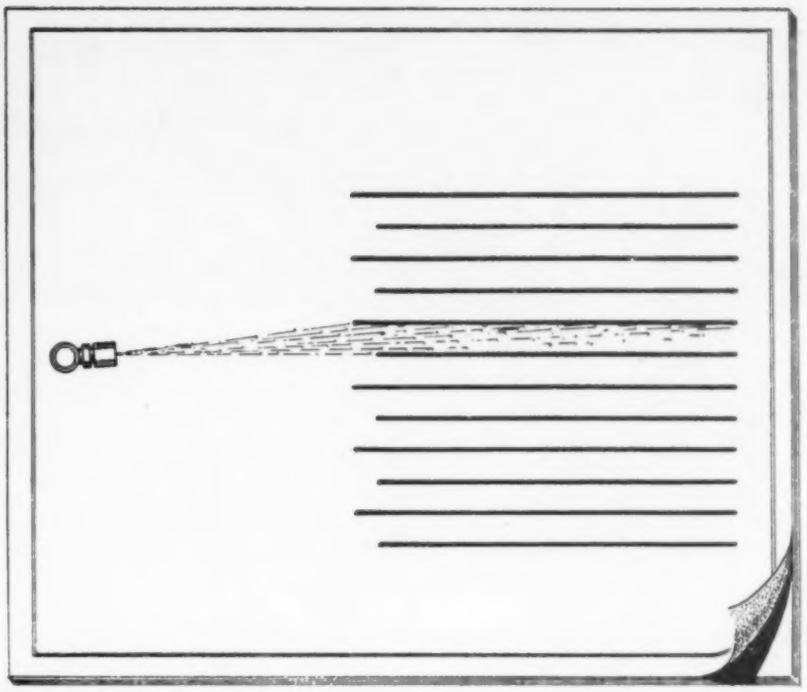
The above illustration shows the hinged ionizer section closed with the new Type "H" Washer in normal position when precipitator is operating. A push-button switch, located on the right-hand side of the above illustration, operates the washer and opens the solenoid valve that controls the water supply. The header makes a complete trip across the face of the precipitator and returns, automatically, to the starting position where it contacts a limit switch that breaks the electrical circuit.



In the above illustration the ionizer section has been opened to show that the washer does not interfere in any way with access to the collector assembly. As in the standard Electro-Cell, the plates are completely removable for thorough cleaning or inspection whenever necessary without the use of any tools or accessories whatsoever.



This illustration shows that the water eliminator frame has been opened to show density of the AMER-*glas* blanket and the ease with which the pad may be removed from the precipitator. If the precipitator is properly maintained and energized electrically at all times during fan operation, the afterfilter will require a minimum amount of attention. Because it is made of fine hair-like glass filaments, the pad is easy and pleasant to handle.



here's the reason for the 5° lead on the traveling spray nozzles on the

ELECTRO-CELL TYPE "H" WASHER

The new type "H" Washer is incorporated as an integral part of the ELECTRO-CELL precipitator and provides "push-button" control of the cleaning operation—thus greatly reducing maintenance and increasing the efficiency of the famous ELECTRO-CELL.

The outstanding feature of the new Type "H" Washer is the rotation of the header at each end of the travel to advance the spray nozzles approximately 5° from the vertical. Result—the best possible penetration of the spray water, assuring thorough coverage of the entire depth of the collector plates with the resulting maximum cleaning action and a minimum of water!

The Type "H" Washer is another "first" from AAF and offers better cleaning efficiency and water economy advantages over the standard fixed-nozzle method of "flooding".

Write the American Air Filter Company for technical data and descriptive information on this latest AAF achievement. And remember—AAF experience will help you solve all your air cleaning problems.

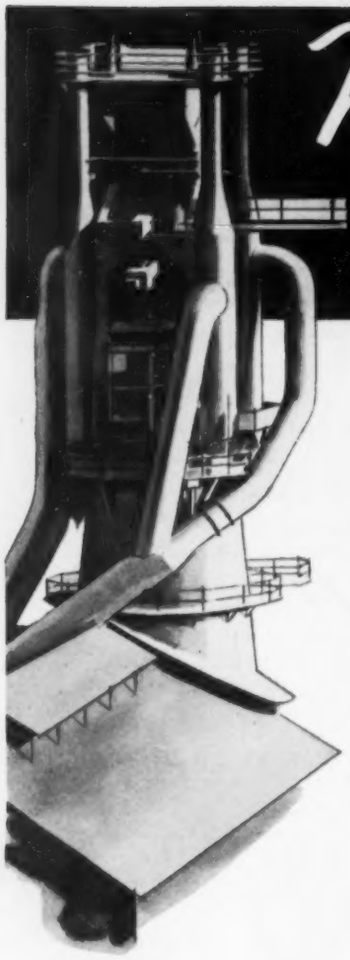
expect the best from ..... AAF

American Air Filter

COMPANY, INC.

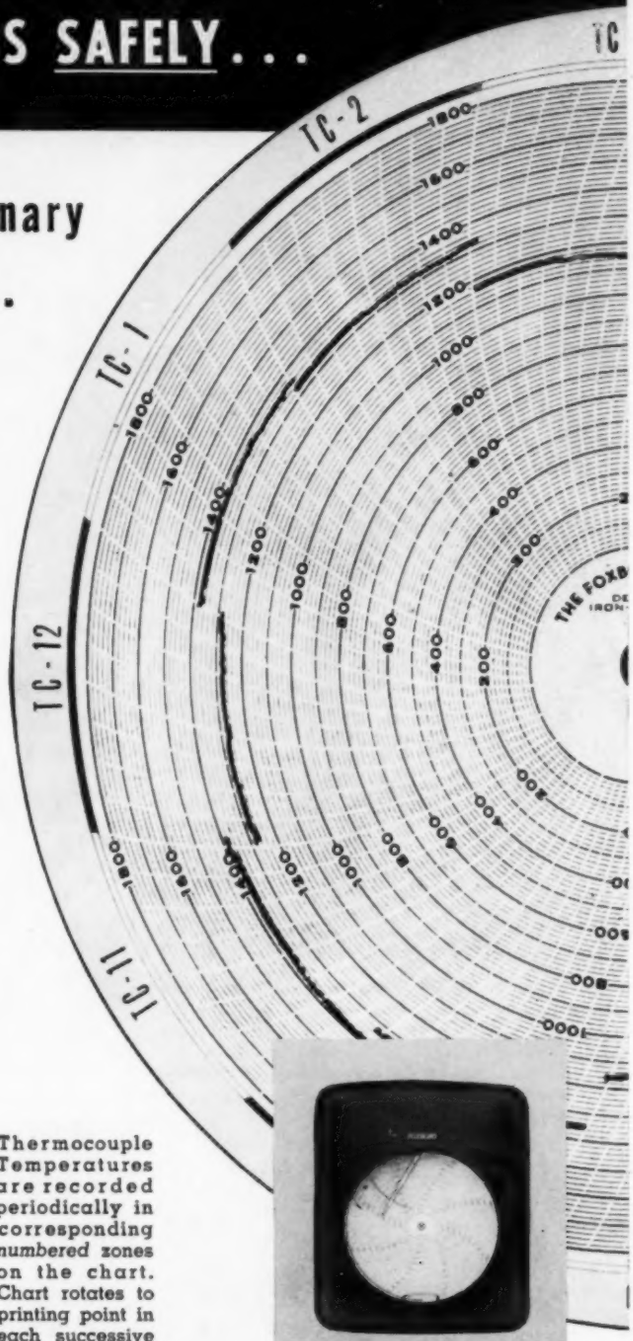
302 Central Avenue, Louisville 8, Ky.

American Air Filter of Canada, Ltd., Montreal, P. Q.



Now . . . EXTEND BLAST FURNACE CAMPAIGNS SAFELY . . .

with revolutionary new recorder... inwall temperatures far easier to read and compare



The exclusive new Foxboro Segmental Chart Dynalog Recorder *separates* records of each inwall thermocouple . . . makes them far easier to read and compare . . . helps the operator get maximum life from furnace linings without risk of breakthrough.

Records of as many as 24 temperature points appear as continuous lines, each in a separate zone of the easy-to-file circular chart. For the first time, it is easy to compare temperature readings from different points, as well as to follow the trend at each thermocouple location throughout the campaign. Hot spots, rate of lining deterioration, and other furnace effects are clearly revealed.

Complete information is contained in Engineering Data Sheet 330-4.
Write for your copy today!

Thermocouple Temperatures are recorded periodically in corresponding *numbered* zones on the chart. Chart rotates to printing point in each successive zone at 1-minute intervals. 24 hour record in each zone . . . other speeds available.

Only the Segmental Chart Dynalog Recorder provides this unique new method of recording multiple temperatures.

THE FOXBORO COMPANY, 5810 NEPONSET AVE., FOXBORO, MASS., U.S.A.

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SEGMENTAL CHART RECORDERS

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

ignition nozzle has been lighted, the large capacity, main oil burner is then turned on with continuous ignition maintained by the smaller pilot burner.

With the supporting base arrangement, the main burner gives the desired vertical firing.

Both the main burner and the pilot burner are of the Hauck venturi high pressure air atomizing type. The high velocity, multiple atomizing ports give complete atomization of oil and economy in the consumption of air atomizing. The Venturi ports cause the oil to be met by the air at its greatest velocity with resulting fog-like atomized oil for good combustion.

The unit saves considerable time and labor in starting up and heating in comparison to wood or coal. Can be used for required heating up of new stoves, or old ones after shut-downs or relining.

The pipe size connections on the burner are 1 in. for compressed air and ½ in. for oil. Thus, the piping or flexible metal hose connections to oil and air supply lines, are quickly handled.

The second illustration gives a larger view of the control valves. Those for oil are the Hauck micrometering type giving uniformly graduated oil control and with indicator dials enabling the operator to easily repeat the proper settings for best results. The upper valves are for the main burner and the lower ones are for the pilot burner. They can be used with any grade fuel oil, in a free flowing condition.

SLIPPER BEARINGS

▲ The durability of "Ryertex," a tough, resilient laminated plastic marketed by Joseph T. Ryerson & Son, Inc., is said to give "Ryertex"

slipper bearings unbeatable resistance to crushing strain, heavy shock loads.

Protective edges of alloyed bronze,

(*Please turn to page 212*)

ROSS MAKES LIGHT WORK OF JOBS LIKE THIS...

Steel plate, I-beams, pipe, lumber, or long pallet loads —this is the fast, simple way to handle it. Ross Carriers go places that other types of equipment can't go. They move your materials indoors or out, over factory floors, unimproved yards or highways. The speed and mobility of these versatile Carriers enables them to handle materials practically anywhere, under all conditions. With them, you move loads between crane-ways, eliminate unnecessary switching between plant trackage, eliminate costly re-handling. They handle the heaviest loads at the least cost.

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A complete line to meet your particular needs. Capacities: 10,000 to 45,000 pounds.
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For 40 years, world's *first* and *foremost* carriers.

The picture above shows a Carrier handling heavy timber arches. In steel mills and fabricating plants as well, Ross Carriers cut the cost of inter-building transfer of in-process material, of indoor or outdoor storage of finished material. It will pay you to look into the advantages of Ross Carriers for your own operations. Write us today—discussion of your handling problems entails no obligation on your part.

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POOLE

A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

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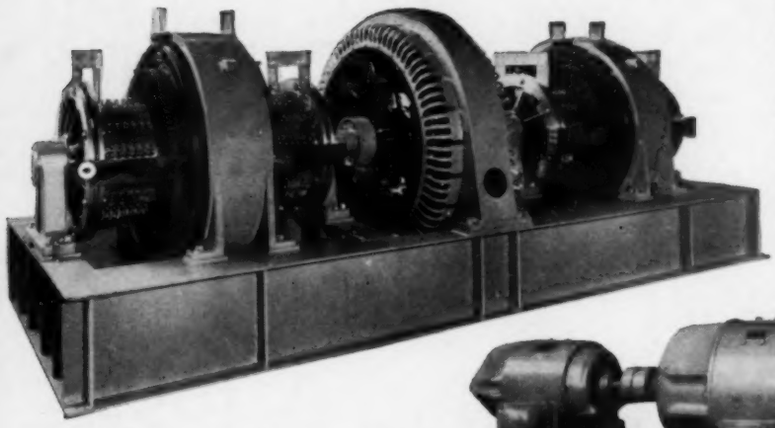
POOLE FOUNDRY & MACHINE COMPANY

WOODBERRY, BALTIMORE, MD.

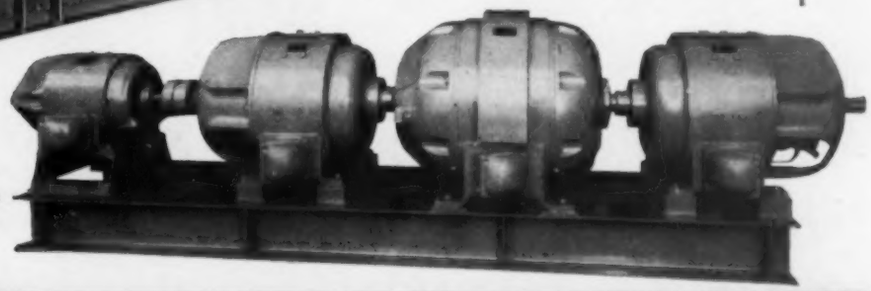
COLUMBIA

MOTOR GENERATORS

● Whether it be for continuous electrolytic tin-plating or electrocleaning lines, or for special power needs, Columbia builds Motor Generator Sets for your individual requirements. They're giving superior, around-the-clock performance in many of the country's leading mills. Illustrated here are typical installations of Columbia generators built to specification.



Two 7500 Ampere 24 volt, 3750 Ampere 48 volt, Separately Excited, Columbia D.C. Generators driven by 600 HP, 1.OPF, 360 RPM Synchronous Motor.



Multi-Unit Columbia Motor Generator Set consisting of two 50 KW, 250 Volt D. C. Generators, and one 10 KW, 50 Volt, 200 Ampere booster Generator, all driven by 200 HP, 0.8PF, 1200 RPM Synchronous Motor.

COLUMBIA ELECTRIC MFG. COMPANY

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TOPS FOR PRODUCTION OF HIGH GRADE STAINLESS, ALLOY AND RIMMING STEELS

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ELECTRIC MELTING FURNACES

EMBODYING the latest in mechanical and electrical equipment, these widely used furnaces are noted for their efficient performance and safety, and low operating cost and maintenance.

We welcome an opportunity to help you select and install the furnace best suited to your particular requirements.

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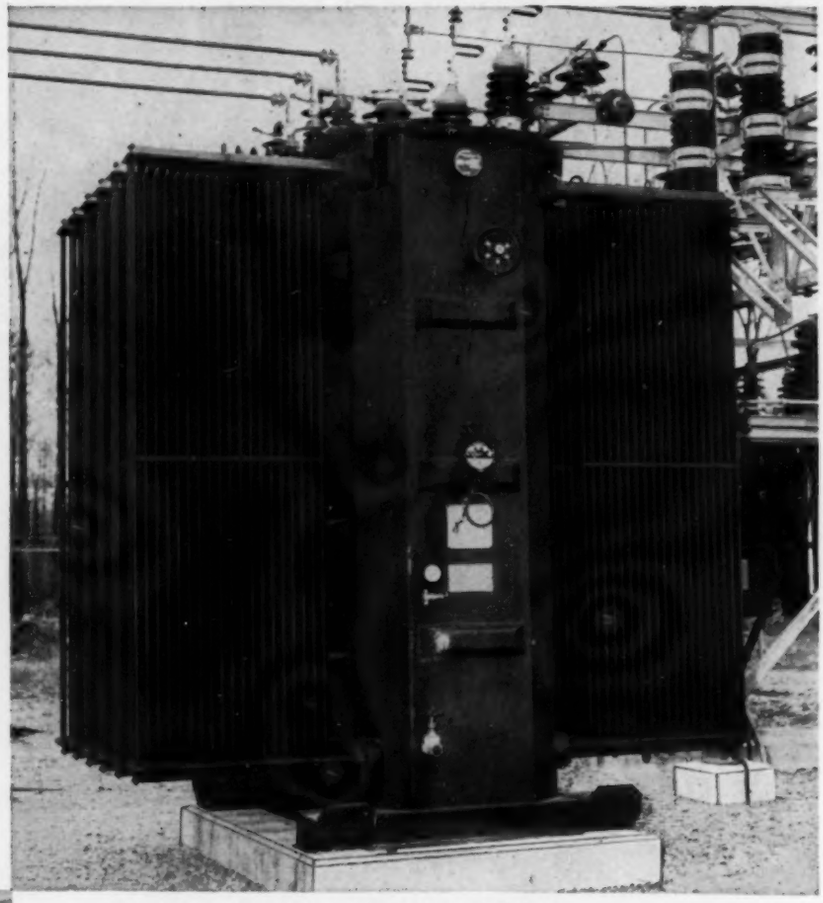
Removable roof of new design now available for large furnaces.

USS

UNITED STATES STEEL

Wagner

Transformers used by Studebaker in new power distribution system planned for present and future needs



6000 KVA WAGNER POWER TRANSFORMER where power is received at 26.4 kv and is stepped down to 13.2 kv for distribution to the seven unit substations in the plant.

1000 KVA WAGNER UNIT SUBSTATION TRANSFORMER, at one of the five load centers that deliver 440 volt, three phase power to large machines and equipment.

New Jersey plant can convert from military to auto assembly production without extensive system changes!

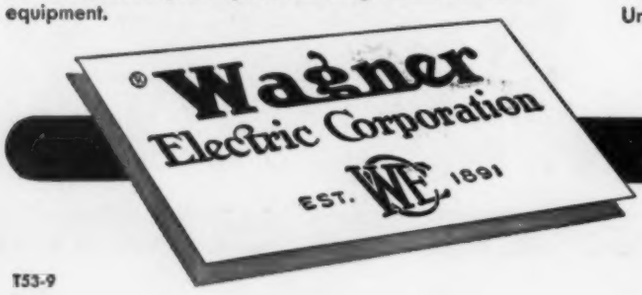
The modern power distribution system at the Studebaker Corporation plant at New Brunswick, New Jersey has been planned with an eye to the future. While the plant is now manufacturing military jet engine parts, it will eventually become eastern auto assembly headquarters for Studebaker.

The power load is divided between seven load center substations, all equipped with Wagner Unit Substation Transformers, spaced 160 feet apart down the center of the building. In addition to insuring an adequate power supply for present purposes, this plan provides a dependable supply of power from short secondary feeders at any time in the future.

* * *

Why not discuss your next transformer installation with the Wagner engineer nearest you? There are Wagner branches in 32 principal cities. Bulletin TU-181 gives full information on Wagner Power Transformers, and Bulletins TU-13 and TU-56 tell about Wagner Unit Substation Transformers. Write for your copies.

WAGNER ELECTRIC CORPORATION
6483 Plymouth Ave., St. Louis 14, Mo., U.S.A.

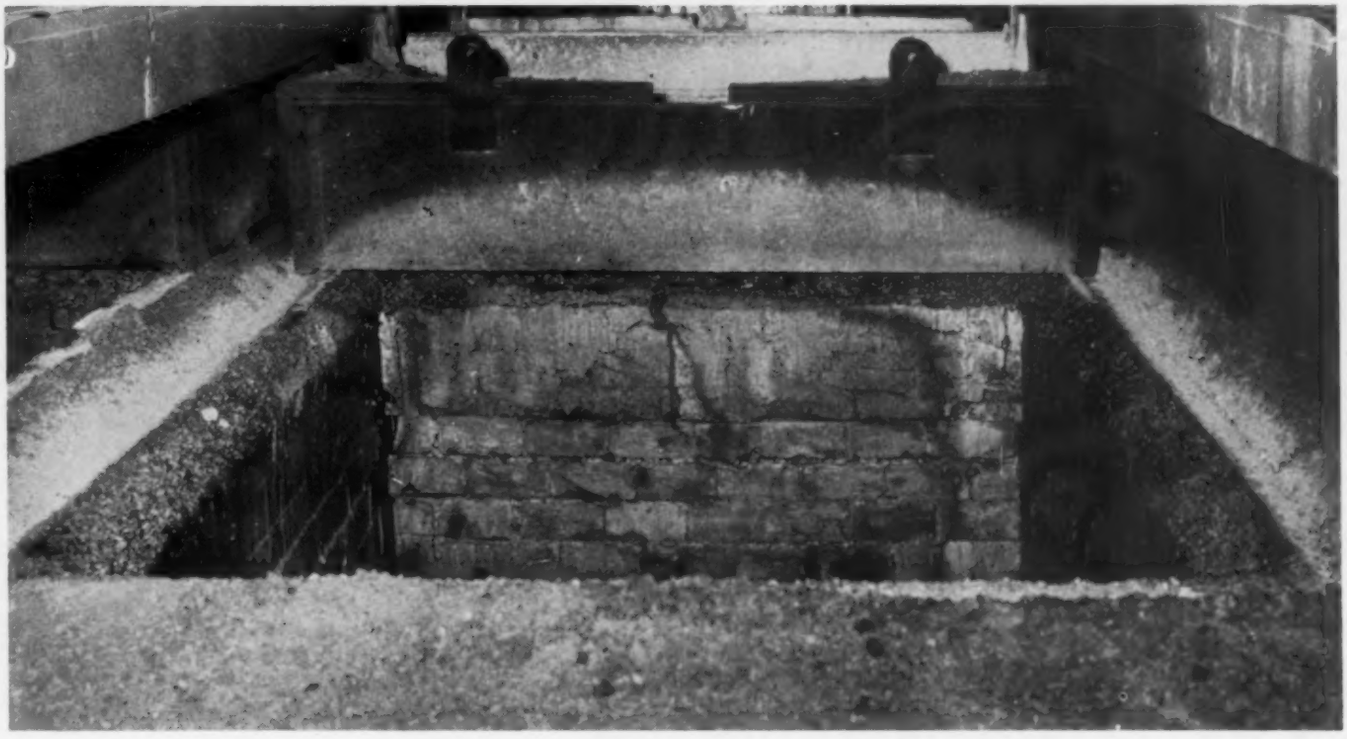


ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS – AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES

T53-9

Compare Ramtite With Any Other Refractory Material . . . .



The use of Ramtite in building soaking pit copings is one of the many applications of Ramtite Plastic Refractory which has been "on-the-job" tested, again and again, proving to many satisfied customers and to us that Ramtite will often give double the life of any other refractory material.

The Ramtite coping pictured above was installed and in service for more than a year before it was photographed. The company for which this coping was installed has expressed satisfaction in the most conclusive way — installing Ramtite copings in over half of their pits, and changing over their other pits as replacements are needed.

Some of the reasons why Ramtite has proven so successful in the construction of soaking pit copings are:

- Ease of Installation
- Inherent Spall-resistance
- Resistant to Physical and Thermal Shock
- A Monolithic Structure: No joints for an ingot fin to hook into

In addition to copings, of course, Ramtite has proven itself the answer to refractory needs in the lining of many soaking pit covers. For more information about the uses of Ramtite Plastic Refractory, write on your company letterhead to:

THE RAMTITE COMPANY
DIVISION OF THE S. OBERMAYER COMPANY
1813 S. ROCKWELL STREET, CHICAGO 8, ILLINOIS

The Ramtite Co. offers you a complete sales-engineering organization — experienced men who are always available to study your refractory problems and consult with your Mason Dept. about your specific case.

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PLASTIC AND CASTABLE REFRACTORIES

The Enterprise Company
BUILDERS OF MACHINERY FOR OVER SEVENTY-FIVE YEARS

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• Pipe Mill Machinery • Lumber Mill Machinery
• Welded Steel Fabrications

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COLUMBIANA 1, OHIO, U. S. A.

You Can Make
3,000* Calls a Day

—BY EXHIBITING YOUR EQUIPMENT
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at the 1954
IRON AND STEEL EXPOSITION

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September 28, 29, 30 & October 1

*Total attendance for four days of the Exposition will be 12,000 or more key executive and purchasing officials of the Steel Industry—your customers and prospects. You can see and sell 3,000 each day!

For Complete Data Write

Association of Iron & Steel Engineers
1010 EMPIRE BUILDING · PITTSBURGH, PA.

(Continued from page 207)

trussed together with high tensile tie-rods, provide these slippers with added strength for remarkably high performance in this tough bearing application.

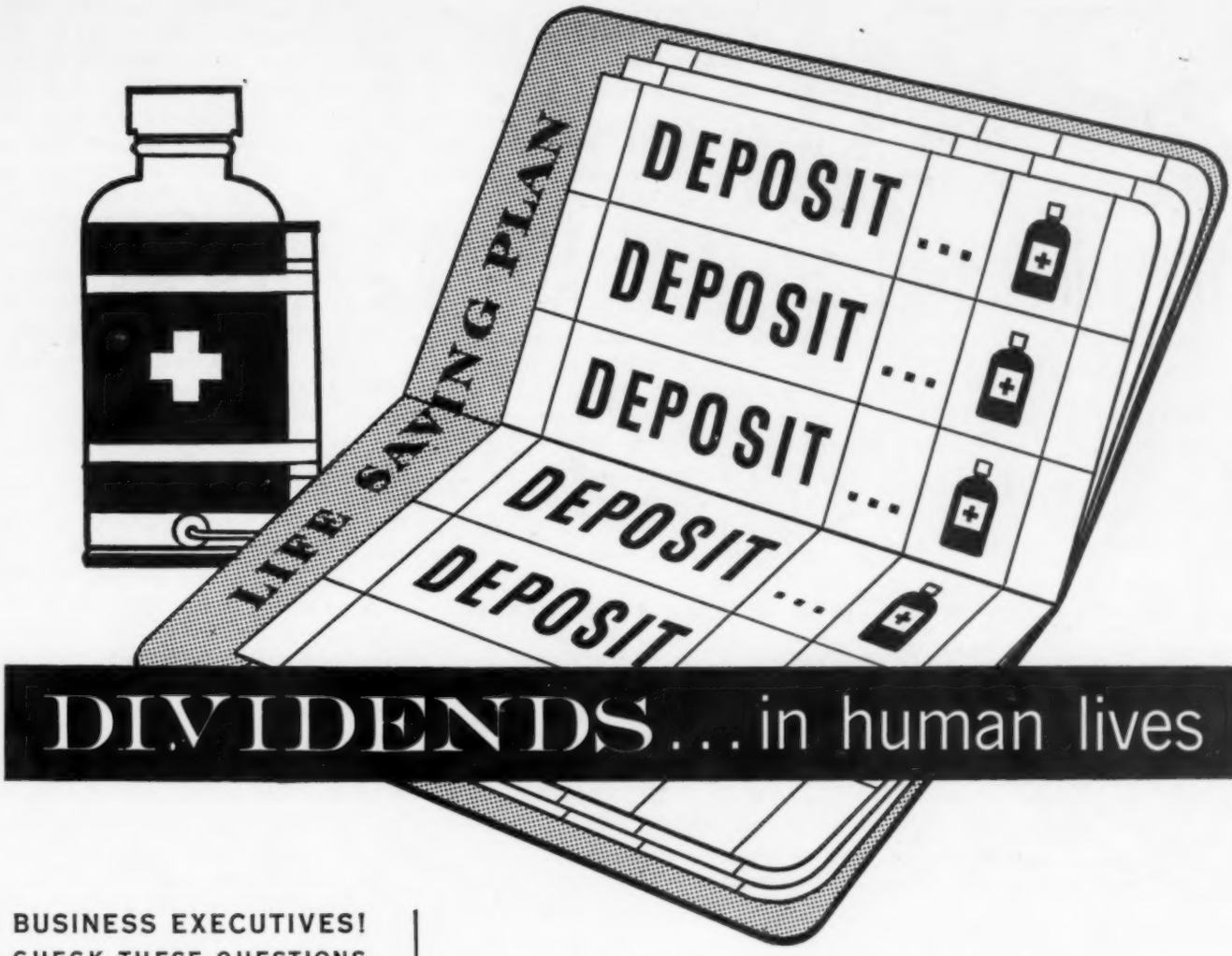
Based on on-the-job mill experience, these slipper bearings outwear metallic slippers many times over. The resiliency of the material absorbs shocks and stresses, reducing wear on large and costly coupling members. The result is that reconditioning and replacement costs are lowered, and production shutdowns are minimized.

These slipper bearings can be made to fit any universal coupling application. Replacement is direct and simple.

MAGNET CHAINS

▲ Steel plants use considerable quantities of electro-magnets for various lifting and transporting jobs. In the tough service which magnet chains, like other lifting equipment, necessarily encounter, excessive wear tends to occur on the carbon steel or wrought iron which were for many years the usual materials employed. These metals also fail frequently from breakage, even when periodic annealing is resorted to in an effort to prevent the grain growth which leads to the embrittlement causing this type of failure.

S. G. Taylor Chain Co., whose "Taylor-Made" sling chains of heat treated nickel alloy steel have solved numerous material-handling problems during the past 15 years, has lately applied its specialized experience to the manufacture of an improved magnet chain. The Taylor Downtown type frictionless magnet chain is designed to eliminate the



DIVIDENDS... in human lives

BUSINESS EXECUTIVES!

CHECK THESE QUESTIONS

If you can answer "yes" to most of them, you—and your company—are doing a needed job for the National Blood Program.

- ○ HAVE YOU GIVEN YOUR EMPLOYEES TIME OFF TO MAKE BLOOD DONATIONS?
- ○ HAS YOUR COMPANY GIVEN ANY RECOGNITION TO DONORS?
- ○ DO YOU HAVE A BLOOD DONOR HONOR ROLL IN YOUR COMPANY?
- ○ HAVE YOU ARRANGED TO HAVE A BLOOD-MOBILE MAKE REGULAR VISITS?
- ○ HAS YOUR MANAGEMENT ENDORSED THE LOCAL BLOOD DONOR PROGRAM?
- ○ HAVE YOU INFORMED EMPLOYEES OF YOUR COMPANY'S PLAN OF CO-OPERATION?
- ○ WAS THIS INFORMATION GIVEN THROUGH PLAN BULLETIN OR HOUSE MAGAZINE?
- ○ HAVE YOU CONDUCTED A DONOR PLEDGE CAMPAIGN IN YOUR COMPANY?
- ○ HAVE YOU SET UP A LIST OF VOLUNTEERS SO THAT EFFICIENT PLANS CAN BE MADE FOR SCHEDULING DONORS?

Remember, as long as a **single** pint of blood may mean the difference between life and death for **any** American . . . the need for blood is **urgent!**

NATIONAL BLOOD PROGRAM

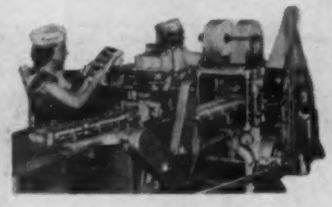
America's blood bank needs **more** blood, **now.** Be a regular depositor and know that your dividend is saving a life of some American—somewhere.

It may be a soldier shot down in battle, suffering from **shock.** Or someone here at home, sick and in dire need of new blood to restore life. A mother in childbirth, or a child in an accident.

America must give. America is **you.** Won't you call your Red Cross, Armed Forces or Community Blood Donor Center right now, for an appointment?

GIVE BLOOD

...give it again and again



"THIS LUBRICANT REDUCES SERVICE CALLS"

—says LYNCH CORPORATION
Toledo, Ohio

"LUBRIPLATE greatly reduces unnecessary wear and prolongs the life of machines. It has reduced customer calls for service to a minimum. Our Service Engineers can readily spot machines that have had other than LUBRIPLATE Lubrication, as these machines do not give the service they should."

For nearest LUBRIPLATE distributor, see Classified Telephone Directory. Send for free 56-page "LUBRIPLATE DATA BOOK"... a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.

REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

friction, twisting and gouging that tends to cause excessive chain wear. The center ring is furnished with a special locating plate which keeps the three separate suspension "legs" 120 degrees apart, thus assuring level lifting and even weight distribution, and making it impossible for the chains to "gang up" on the ring.

In addition to the design advantages, the entire assembly — chain links, ring and all — is made from TM alloy (nickel molybdenum) steel, heat treated to provide the optimum combination of strength and toughness. The superiority of the nickel alloy steel for chain use has already been thoroughly demonstrated by its service in Taylor sling chains.

The high tensile strength of this magnet chain, twice that of wrought iron chain, permits smaller diameters to be safely used on any given job. A 1¼ in. diameter 3-leg alloy steel chain on a 65 in. magnet will lift loads up to 110,000 lb.

Moreover, the alloy steel chain never requires annealing, and is highly resistant to shock at both normal and sub-zero temperatures, to work-hardening effects and to fatigue stresses. Maintenance engineers have reported 5 times longer life than previously used materials, which adds up to a definite long-range economy for the user.

ROLLS PRODUCTION

▲ The Rolls Division of Blaw-Knox Co. has recently completed a two and one-half year program of plant expansion and modernization for the production of cast iron and steel rolls. The new facilities will be used for the manufacture of cast iron rolls for the Lewis Rolls department and cast iron and cast steel rolls for the Pittsburgh Rolls department of the company.

All iron roll manufacturing is now under one roof at 41st and Willow Streets in Pittsburgh, Pa. Ample provision has been made to allow for the production of the separate grades of the Lewis Rolls department and those of the Pittsburgh Rolls department.

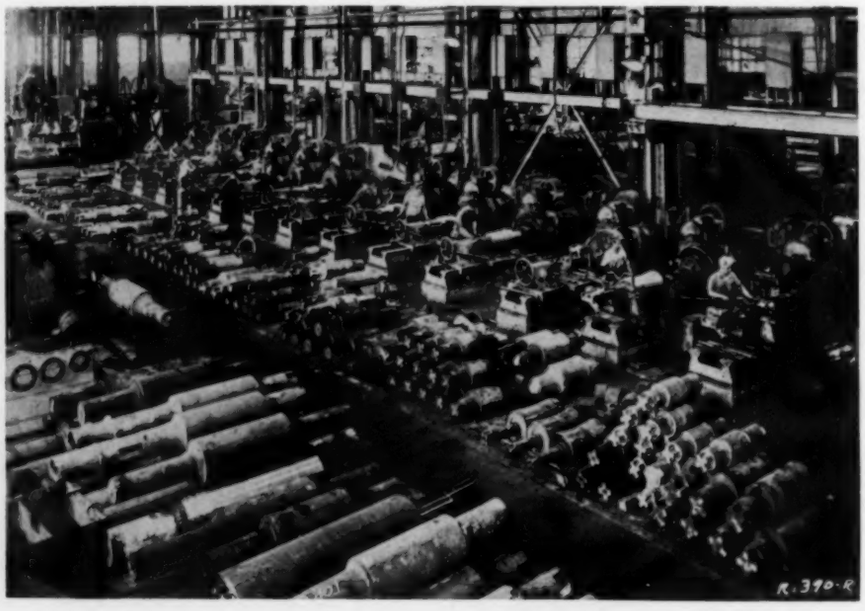
Steel roll manufacturing has been moved to the 62nd and Butler Streets plant to take advantage of the steel melting facilities of the Union Steel Castings Division.

In the iron roll plant a completely new layout for more efficient material and product flow is featured. New melting facilities in the foundry include three modern top-charged air furnaces of 20, 30 and 36-ton capacities with an air conditioned crane for charging, and a 12-ton per hour cupola with mechanical charging equipment.

Coal and coke handling and storage problems are eliminated by a completely mechanized system using silos, elevators and feed screws. Eight new recirculating mould drying ovens, a vibrating sand shakeout machine, and a sand reclamation, storage, and handling system complete the foundry modernization.

Seventy-four per cent of the machining facilities are either new or have been rebuilt and relocated. Some of the new machines which were installed include a 36-in. roll grinder,

Shown is a roll shop bay in the newly-completed iron foundry of the Rolls Division of the Blaw-Knox Co. in Pittsburgh, Pa.



In your open-hearths...
wherever you use
silica refractories...

USE TAYCO-40

SILICA CEMENT

Tayco-40 High-Temperature Silica Cement is unsurpassed for bonding silica and super-duty silica brick and shapes. Spalling is definitely retarded when furnace roofs and side walls are laid with Tayco-40. Having a softening point nearly equal to the best grades of silica brick, Tayco-40 will *not* run out of joints at temperatures up to 3100° F.

Tayco-40 has excellent water retention properties which make it the most workable, easy-to-use silica cement obtainable. Use it for dipped, poured or trowelled joints. When applied to porous silica brick, Tayco-40 remains plastic longer, allowing ample time for proper laying and fitting of the brick. Because of its smooth workability, Tayco-40 goes 2½ times as far as ordinary silica mortars. Thinner, tighter joints are obtained; losses in mixing and handling are reduced.

The majority of steel mills in the United States have found it economical to use Tayco-40. Try Tayco-40 for hot repairs and for your next furnace re-build. Properties and service data are given in Bulletin 507. Write for your copy.

Exclusive Agents in Canada:
REFRACTORIES ENGINEERING AND SUPPLIES, LTD.
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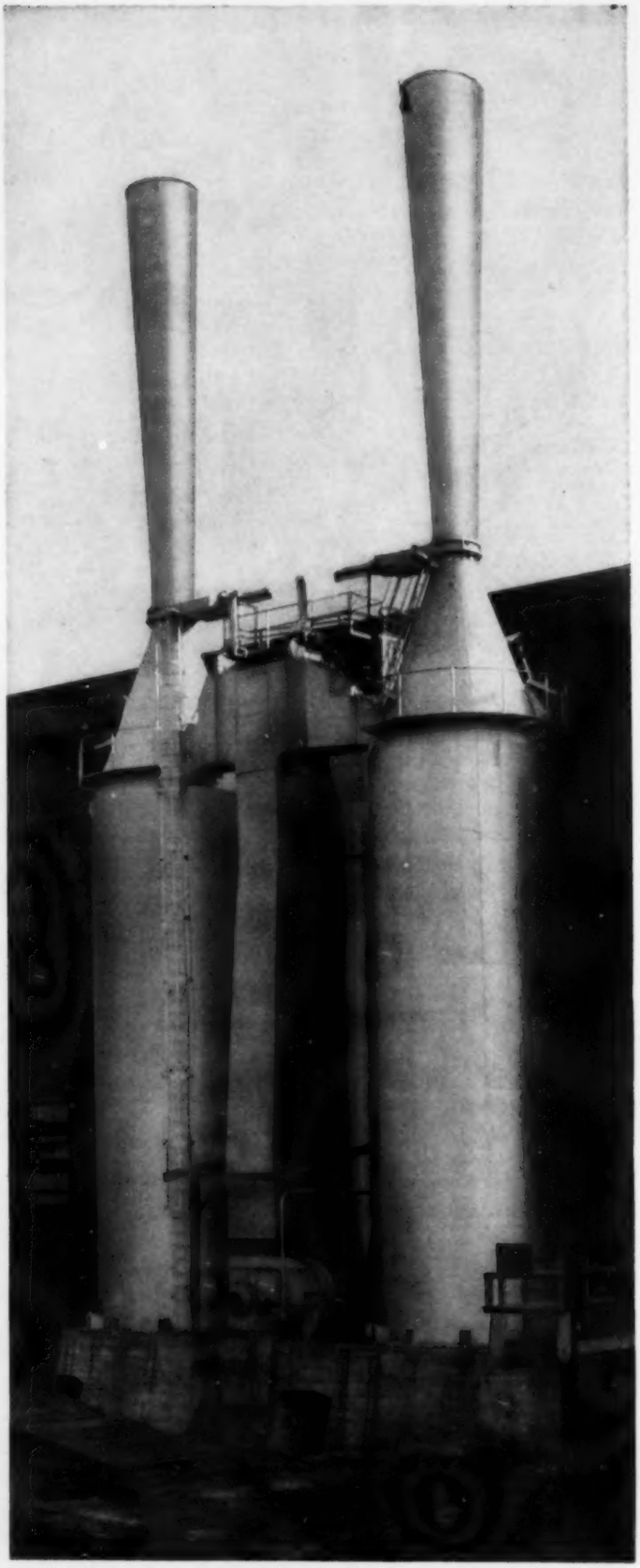
PHOENIX Installs Morgan-Isley in place of Natural Draft System

This Morgan-Isley System was erected by the Engineering and Construction Departments of The Phoenix Iron & Steel Company, Phoenixville, Pa. while the furnace was in operation. This is a 150 ton furnace using all cold metal charge. When necessary, the system burns up to 600 gallons of oil per hour.

The furnace was changed over from natural draft to Morgan-Isley in 10 days time by connecting the new flues to the checker chambers. All work necessary for the changeover was done by the maintenance personnel of Phoenix Iron & Steel Company.

The unusual thing about this installation is that it was built wholly above ground. The secondary checkers are 40 feet high. This demonstrates the adaptability of the Morgan-Isley System to almost any condition as to location or use.



CCC-40

MORGAN CONSTRUCTION CO.

WORCESTER, MASSACHUSETTS

ROLLING MILLS - MORGOIL BEARINGS - REGENERATIVE FURNACE CONTROL - EJECTORS - WIRE MILLS - GAS PRODUCERS

a 50-in. Lewis fully hydraulic roll lathe, a two-spindle heavy duty milling machine, and an abrasive cut-off machine for cutting off heads. The large roll lathes are fully equipped with hydraulic tool push-up equipment developed by Blaw-Knox.

A central maintenance department has been created in a separate bay, housing the machine, welding, electrical repair and blacksmith shops. Also included in this bay are completely new and expanded tool and templet making facilities.

In the transfer of the steel roll operations to the 62nd Street foundry, the company erected a new building, 70 ft by 900 ft, to house roll cleaning, annealing, machining, grinding and shipping facilities. A bay, 75 ft by 300 ft, in the original foundry was turned over to steel roll moulding and casting. Melting is done in the three existing acid open hearth furnaces. The roll moulding bay was equipped with new, heavier cranes and three electric hot tops to make it possible to handle the roll founding.

For individual steel roll heat treatment, the new roll shop building has been equipped with twelve new box-type annealing furnaces and one large pit-type furnace. The larger lathes are equipped with hydraulic tool push-up. New production machines include a 60-in. roll grinder, a single spindle heavy duty milling machine, and a 60-in. fully hydraulic Lewis roll lathe. The large lathes were provided with equipment for the automatic disposal of turnings.

Concurrent with the plant expansion program, a new, expanded program for quality control was installed. This includes a new metallurgical laboratory designed specifically for roll metallurgy. A roll research metallurgist is in charge of laboratory operations and also coordinates research work with current customer needs. An addition of the staff of each foundry has been a quality control metallurgist whose duty it is to oversee and inspect all phases of metallurgical quality not normally handled by the Inspection Department. For inspecting the internal quality of the rolls, a system of ultrasonic testing with photograph recording of the sound test graphs, has also been established. A complete manufacturing and service record system has been installed to assist in quality control analysis.

In conjunction with its roll manufacturing operations, the Rolls Division of Blaw-Knox Co. also maintains a highly competent roll engineering department which provides service to Blaw-Knox's customers on their roll design problems.

The new set-up reflects a determined effort to provide the best in modern roll making facilities to supply the users of rolls with a high tonnage, high quality product.

MAGNETIC DRIVES

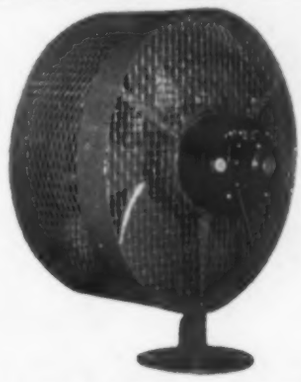
▲ Harnessing waste heat from open hearth furnaces is a tremendous job, and one that requires precise control of draft fan output.

At the eastern mill, induced draft fans draw the hot gases out of the furnaces and through waste heat boilers recently built. Power from 200 hp, 720 rpm, 1.0 power factor synchronous motors is delivered to four fans through the Electric Machinery Mfg. Co. 705 rpm magnetic drives.

Air flow must be carefully controlled in this operation. The pressure at the center of the furnace must be held almost perfectly steady. When the

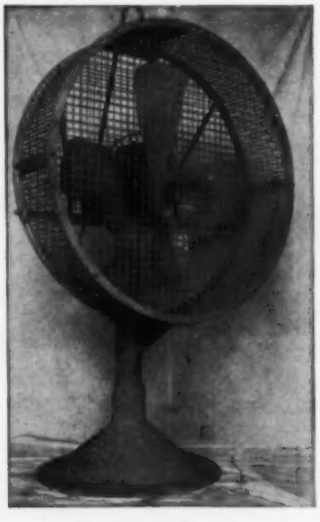
(*Please turn to page 221*)

IS HEAT SLOWING UP YOUR WORKMEN?



TRUFLO CRANE CAB FANS
For cooling interiors of crane cabs and other confined areas. Adjustable both horizontally and vertically. Four blade type, 12 and 18 in. sizes.

Keep them COOL with TRUFLO FANS



TRUFLO PORTABLE COOLING FANS
Easily portable. Help keep efficiency high where work is hottest. 12 to 36 inch diameters.

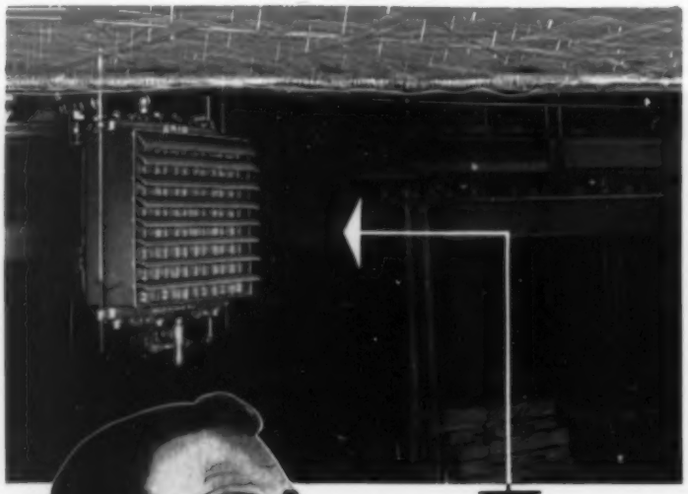
Production suffers when workmen are overheated. Steps begin to drag, efficiency falls.

Now, when speedy production is vital, Truflo Fans can help keep your workmen on their toes. All Truflo Fans are designed and built correctly to put fresh cool air *in large volumes* exactly where it is needed. Perfectly-balanced shafts and blades give more air per h.p. . . . strong steel frames stand up longer under hard use . . . rugged wire guards protect men against injuries.

All of the following types can help beat the heat, keep production moving in your plant. Write for illustrated literature.

PORTABLE COOLING FANS
CRANE CAB FANS • WALL FANS
EXHAUST FANS • BLOWERS
ROOF VENTILATING FANS
PENT HOUSE FANS

TRUFLO FAN COMPANY
245 MAIN ST. HARMONY, PA.



Put up to Stay up!

trouble free service for over 22 years...that's only one record for...

GRID UNIT HEATERS

That's the experience of a midwest steel mill who tell us: "We have in service GRID Unit Heaters Type No. 2500. A number have been in use for approximately 22 years on very severe service with steam turned on and off rapidly several times each day. Even under this severe service we have found them maintenance-free." There's the word of a mill operator who has proved that, with a GRID installation, first cost is last cost. Such service records (GRID installations made in 1929 are still operating) are the rule rather than the exception with GRID Unit Heaters because . . .

GRID is an all cast unit with finned heating sections and headers tested to withstand steam pressures up to 250# P.S.I.

GRID construction uses no brazed, soldered, rolled or welded connections between condenser and headers. A specially designed threaded nipple assures a precision, leak-proof fit.

GRID construction has all similar metals in contact with steam, thus preventing electrolytic corrosion which eventually occurs in copper type unit heaters where steam passes from iron pipes into copper cores. (Write for booklet CORROSION IN UNIT HEATERS.)

GRID construction resists corrosion from fumes present in most types of industry.

GRID design incorporating low outlet temperatures, proper fan sizes and motor speeds, assures delivery of warm comfortable air in ample volume to the working level. No stratification of warm air at the ceiling to waste your fuel dollars.

These are the reasons why steel mill operators get 22 years and more of trouble-free service. There are units cheaper than GRID, but there is none better. You start saving money the day you install GRID UNIT HEATERS. Get the complete GRID story. Write for catalog CUH-846-A.

Eastern Stainless Steel Corp. uses GRID BLAST COILS for sheet drying. Write for Catalog BC-1049.

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ONLY EUCLID CONTACTORS HAVE ALL TEN

1. Stamped-steel, welded construction that assures extra strength.
2. Light-weight, fast-moving parts that provide quick operation. No die-cast parts.
3. Self-lubricating, porous-bronze bearings.
4. Compact design... lessens required mounting space.
5. Lift-off arc shields for quick contact inspection.
6. Standard electrical interlock has normally open and normally closed contacts, electrically separate.
7. Stainless-steel springs on both auxiliary and main contacts.
8. Extra wide, heavy-duty contacts (¾").
9. Arc-centering feature... assures longer arc-shield life.
10. Unusually high rupturing capacity... highly efficient blow-out system.

Ask your E.E. Representative for more information, or write:

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WALKER PROCESS means leadership

in the design, manufacture and installation of process equipment for the handling and treatment of solids-in-liquid combinations

INDUSTRIAL LIQUIDS
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GET DEEP-DOWN PULLING
with Stearns Lifting Magnets

A Stearns power-packed lifting magnet provides a tremendous pulling force that reaches well into the body of the load it is lifting. That's why it safely hoists and swings heavy loads even though only a small surface touches the lifting magnet. This is a big advantage for quickly moving bulky units out of cramped quarters. With a Stearns magnet you eliminate straps, slings and other devices — save hours of material handling time.

Stearns lifting magnets are available in standard or special sizes and designs. Nearly 40 years of research and engineering experience is at your disposal. Write today for information.

Check these Features

- ✓ *Permanently sealed magnet coil not disturbed when servicing terminals or pole shoes*
- ✓ *Leads and terminals fully protected against abrasion and shock*
- ✓ *Vacuum-impregnated windings assure long-life electrical operation*
- ✓ *Waterproof construction*
- ✓ *Fast heat dissipation*
- ✓ *Rugged, all-welded or bolted construction*

Here a Stearns magnet lifts an 8,000-lb. casting. Note small point of contact — a real test of deep-down pulling power.

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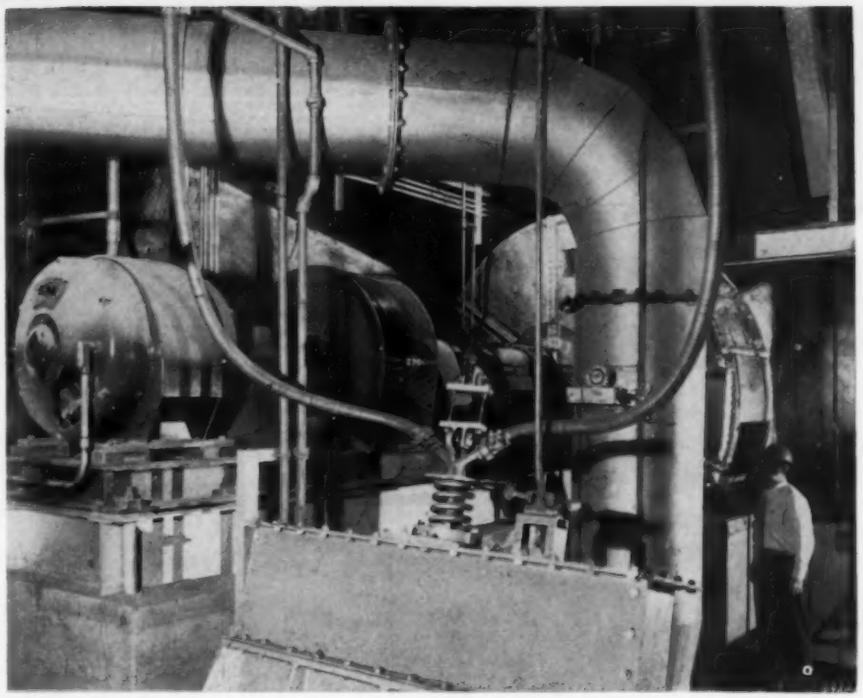

Magnetic drives regulate draft fans drawing waste heat from blast furnaces.

(*Continued from page 217*)

pressure rises slightly, the magnetic drive automatically increases the speed of the fan and the increased pull offsets the rise. The magnetic drive decreases the speed of the fan to offset a drop in furnace gas pressure.

Control of the fan may be accomplished with other variable speed drives, such as 2-speed motors, slip ring induction motors, and fluid drives, or by constant speed motors where the fan is equipped with inlet vanes or outlet dampers. But the degree of precision obtained differs widely among the various methods. The cost of maintenance and operation may be considerably higher, and the range of fan output smaller.

In this particular installation, pressure changes in the open hearth furnace are sensed by a pneumatic control. A build-up in pressure sends a signal to the "Regutron" controlling the output speed of the magnetic drive. The drive automatically decreases the speed of the induced draft fan. As the fan speed drops, the furnace pressure returns to normal.

When the boilers are shut down for maintenance or repair, which is done about once a year, the fans are used to draw cool air through the system to improve working conditions.

The synchronous driving motor is connected to the "ring member" of the magnetic drive. A "magnet member," within the ring member, is connected directly to the fan. As the motor drives the ring member at constant speed, the magnet member tends to follow because of electromagnetic interaction. How closely it follows depends on the strength of the magnetic field, or in other words, on the amount of current through the field windings. There is no physical connection between the two members of the drive. The speed is varied by merely increasing or decreasing the current through the magnet windings.

The magnetic drive overcomes many disadvantages found in other methods of controlling draft fan output. Note the following: 1. High overall efficiency — The magnetic drive has a higher average efficiency over its operating range than other means of controlling fan output. Heat generated is dissipated in the drive itself. No special cooling equipment is necessary. 2. Wide operating range — Fan speeds can be varied down to about 10 per cent of full speed, affording a wider range than is possible with other variable speed drives. 3. Precise control — Fan speed may be increased or decreased smoothly in such small increments that control is practically stepless. 4. No outlet damper or inlet vanes required — The induced draft fan can be run at any desired speed within the operating range, thus obtaining the desired fan output. No damper is needed to give the desired degree of control, as is necessary with constant speed, 2-speed, and multi-step drives. 5. Long

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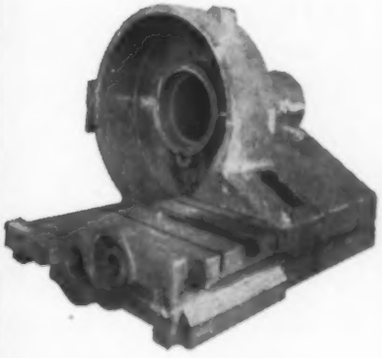
Castings of any size up to 80,000 pounds. Hyde Park facilities are equal to your every requirement

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This completely new trolley conveyer, designed to meet the requirements of the most discriminating buyer, is the result of five years of intensive development by Mathews Engineers. The top-quality precision wheel, with hardened races, is the heart of this rugged newcomer to the fine 4" trolley conveyer field. For the overhead conveying job that demands stamina and exceptional performance, we believe the No. 4207 Loadstar is without equal anywhere.

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life for fan rotors — Fan blade erosion results when the fan is run against abrasive gases while the outlet damper is partly closed. With the magnetic drive, no damper is necessary, and the fan is not run at full speed when output is reduced. Rotor life, therefore, is substantially increased. 6. Power factor correction — Since synchronous motors can be used with the variable speed magnetic drives, the power factor situation may be improved instead of becoming more serious when the motor is put on the line.

EXTRUSION PRESS

▲ Sutton Engineering Co. has announced completion of engineering and design of a new horizontal direct extrusion press.

To be the first of a new line manufactured for the non-ferrous metal industry, the new Sutton machine is a 750 ton direct powered unit. Now under construction, it is scheduled for completion early in October. Other sizes will follow later.

The manufacture of extrusion presses, according to John B. Sutton, Jr., president, is a logical step for the company which has provided other equipment in this field for years and will now be able to furnish complete extrusion plants.

The trailer is 24 in. high, 3 ft wide and 8 ft long. Steel frame members support 1¾ in. selected hardwood deck. Rear load wheels are fitted with 15 in. × 5 in. rubber tires and caster wheels are fitted with 12 in. × 4 in. rubber tires. All wheels are equipped with solid pressed-on rubber tires and are mounted on Hyatt roller bearings.

Variations in deck sizes and types of deck construction are optional. Side boards shown in photograph are also optional.

SPEED REDUCER

▲ Designed for use as a conveyor drive, this worm gear speed reducer, manufactured by Philadelphia Gear Works, Inc., incorporates an automatic and instantaneous shut-off device for overload protection. This feature, known as a double torque control, eliminates the need for a sheer-pin coupling and has decided advantages over the latter means of protection.

(*Continued on page 228*)

MARTINDALE

MODEL 52 V.A.O. TESTER

This new, sturdy, portable instrument has 5" meter — Four testing ranges: Volts, AC and DC: 0-2.5-0-10.0-50, 0-250, 0-1000, Amperes, DC only: 0-10; Ohms: 0-1000, 0-10000; Megohms: 0-1, 0-100. Selector Switch provides four positions: Volts AC, Volts DC, Ohms, Amps. Range Switch has 5 positions which provide for above Voltage ranges, 4 ohm ranges, and 1 ampere range. 4' test lead has both prods and alligator clips. Has sturdy, leather carrying case.

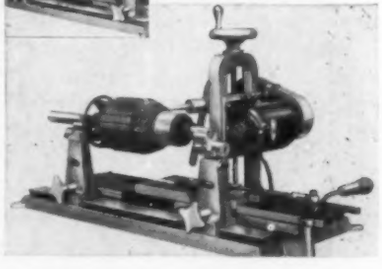
MARTINDALE GROWLERS

Portable Growler Type U-2

This universal adjustable growler can be used as an external growler for armatures (from 2" diam. up) and internal growler for stators (from 5¾" diam. up). 110 volt, 60 cycle. Write for prices on this and five other types.

BENCH-TYPE UNDERCUTTER

AT LEFT—Undercutting Vertical Commutator.
BELOW—Undercutting Horizontal Commutator. Note V-support at right raised to compensate for smaller shaft diameter.



Model HV-3 is a precision built, rugged, fast and accurate undercutter with a wider range of armature sizes and shaft lengths than any similar machine being built.

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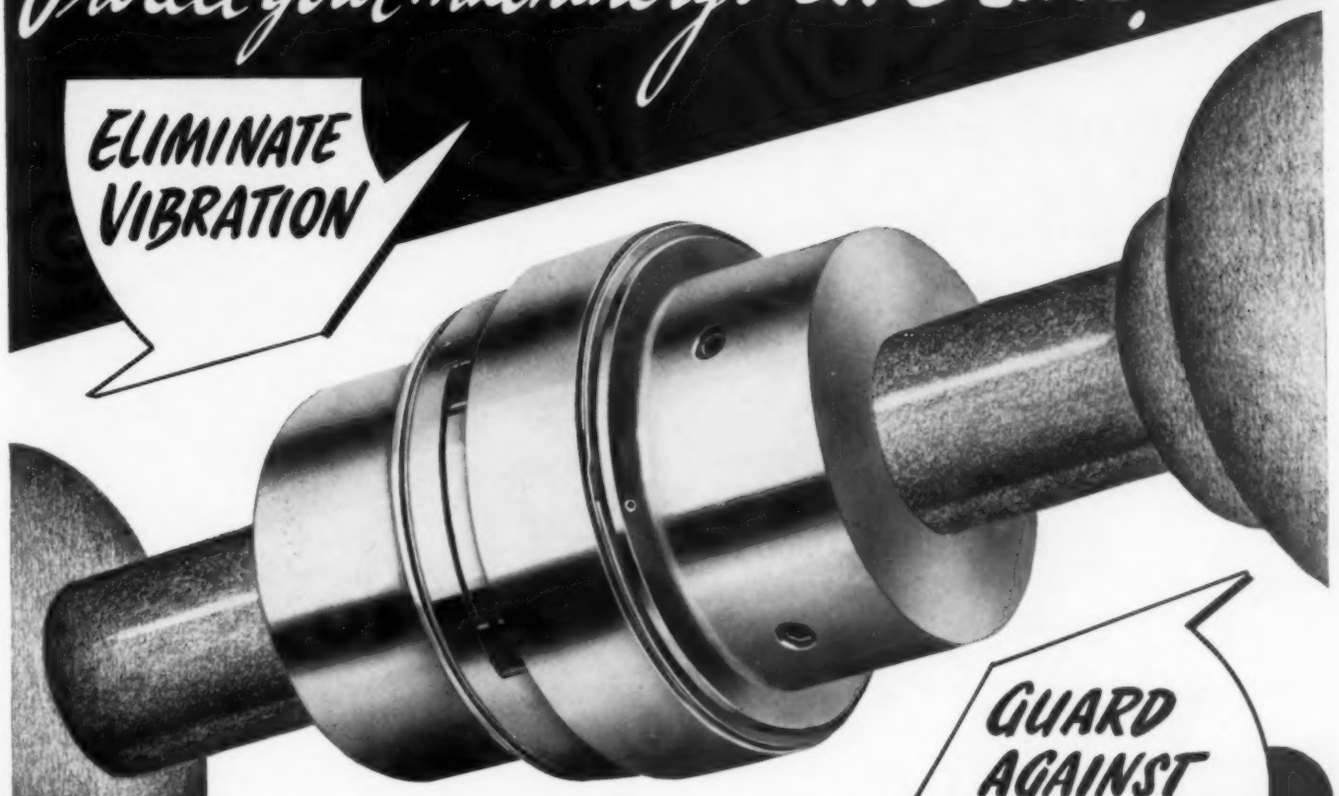

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When you install Lovejoy Couplings, you guarantee your machinery the benefits of years of coupling design and engineering experience. You know that smooth, steady power transmission will keep your runout tables, conveyors, hoists, pumps and other production equipment operating at peak efficiency.

Note the compact, accurately machined bodies and jaws—the special cushioning materials—and you'll see why Lovejoy spells the end of your "down-time" worries...why misalignment, backlash, and surge are reduced to a bare minimum.

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ROBERT E. GROSS

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National Chairman, 1953 Aircraft
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"A man's personal economic security is the sum of his own diligent effort, a financially sound government and a systematic savings plan. He has the earnings and he has the government that can protect the individual. However, human nature being what it is, not everyone maintains a systematic plan of savings. So here is a plan designed to help the employee—the Payroll Savings Plan, whereby his company will regularly invest a part of his earnings (he specifies the amount) in United States Savings Bonds, America's safest form of investment. We at Lockheed have endorsed and encouraged this plan because we know what it does to assure security—both individual and national."

Lockheed Aircraft Corporation recently conducted a person-to-person canvass that put a Payroll Savings Application Blank in the hands of every employee of Lockheed's eleven plants in Southern California. At the conclusion of this one-week campaign, 36,419 of the 38,037 employees—95.7%—had signed up on the Payroll Savings Plan. Three of the eleven plants achieved 100% enrollment.

Lockheed's 95.7% in the Southern California plants is the highest employee participation of any company or group of this size this year. The previous national record in the aviation industry—92%—was set by Lockheed's Georgia Division in April, 1953. Of Lockheed's total payroll—50,000 men and women—94.9% are building ". . . security—both individual and national" by systematic investment in U.S. Savings Bonds.

45,000 companies operate Payroll Savings Plans. In many of these companies employee participation ranges from 60% to 80%; in some, it is even higher. On the basis of Payroll Savings Records, it is safe to estimate that 60% or more of the personnel of a company will join the Payroll Savings Plan—

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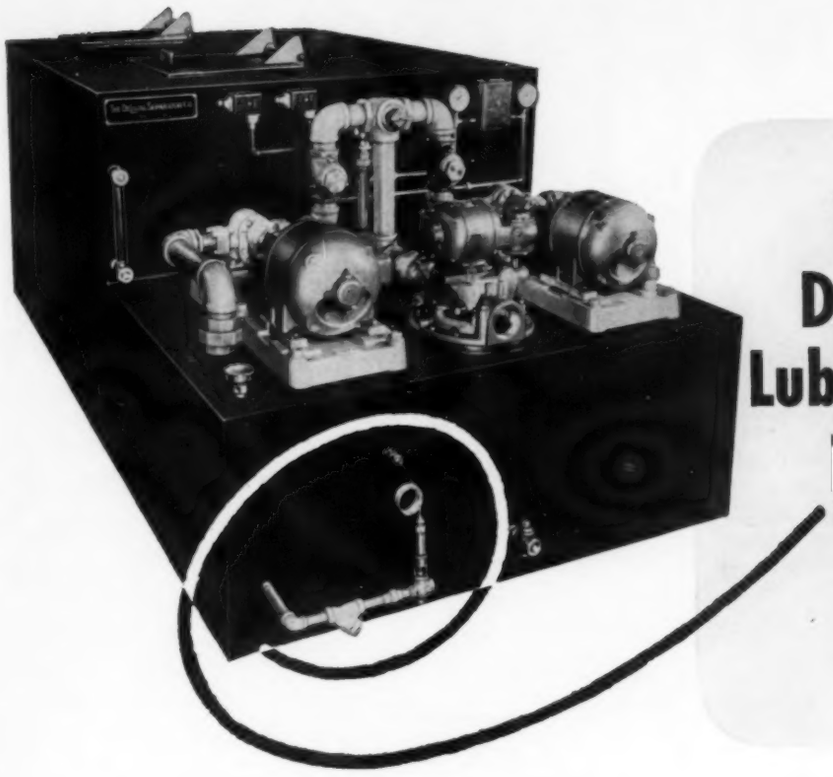

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On large, custom-built De Laval Lubrication Systems, where several thousand gallons of oil are stored in the reservoir, condensate temperature control valves save a good deal of steam. In itself, the right valve is a small thing, but as part of the engineering whole, it is extremely important.

De Laval engineers, in designing either a custom-built system or in recommending a self-contained Unilube system, insist that every detail . . . every control auxiliary . . . be as good as the best engineering can make it. For in mill lubrication systems, as in the famous old axiom, "The whole is equal to the sum of its parts."

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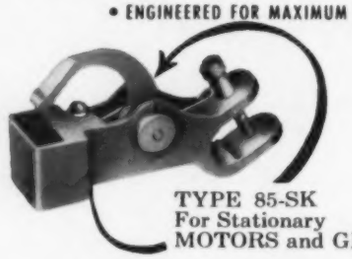

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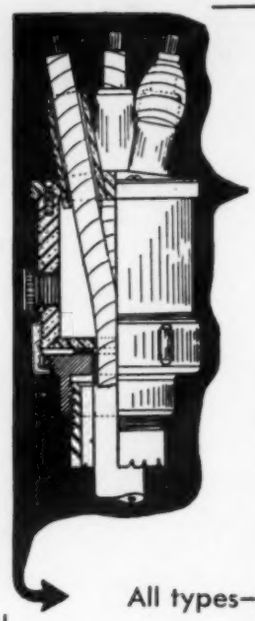

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Must have experience in general steel plant maintenance and construction. Eastern location. Give full details as to training, experience, age and salary expected. Box 1002, IRON AND STEEL ENGINEER, 1010 Empire Bldg., Pittsburgh 22, Pa.

EQUIPMENT NEWS

(*Continued from page 222*)

When a predetermined load limit is reached, motor current is immediately cut-off by direct mechanical action of the overload.

To re-start operation after overload cut-off, only removal of excessive load is necessary. No re-setting or replacement of parts are necessary a considerable time saving feature.

Recommended uses include conveyor drives, stoker drives, roll drives, tumblers, and many others.

A wide range of horsepowers and ratios from 3⅝ to 1 up to 6300 to 1 are available.

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An eastern plant of a large steel corporation with wide production facilities for various type products has openings for qualified personnel to fill above positions. Steel mill experience a necessity in each case with plate mill experience preferred. Advise education, experience, age, and desired salary. Box 1001, IRON AND STEEL ENGINEER, 1010 Empire Building, Pittsburgh 22, Pa.

FORK TRUCK

▲ A ruggedly-built, electric-powered fork truck, ideal for operations in steel mills and metalworking plants, has been announced by Elwell-Parker Electric Co. The truck, Type F-39T10, has front-wheel drive, rear-wheel steer, and has a capacity up to 10,000 lb with a 48-in.-long load. Dimensions: length, overall, less forks, 97 in.; height, uprights telescoped, 83 in.; with uprights extended, 146 in.; maximum lift, 110 in. The truck turns in intersecting aisles of 83 in. (when equipped with 42 in. forks). Travel speeds: without load, 4.5 mph; with full load, 4 mph.

This 10,000 lb. capacity electric-powered fork truck features a contractor control with four speeds forward and four reverse. Levers control hoist unit which contains a single, low-pressure simplex hydraulic cylinder.

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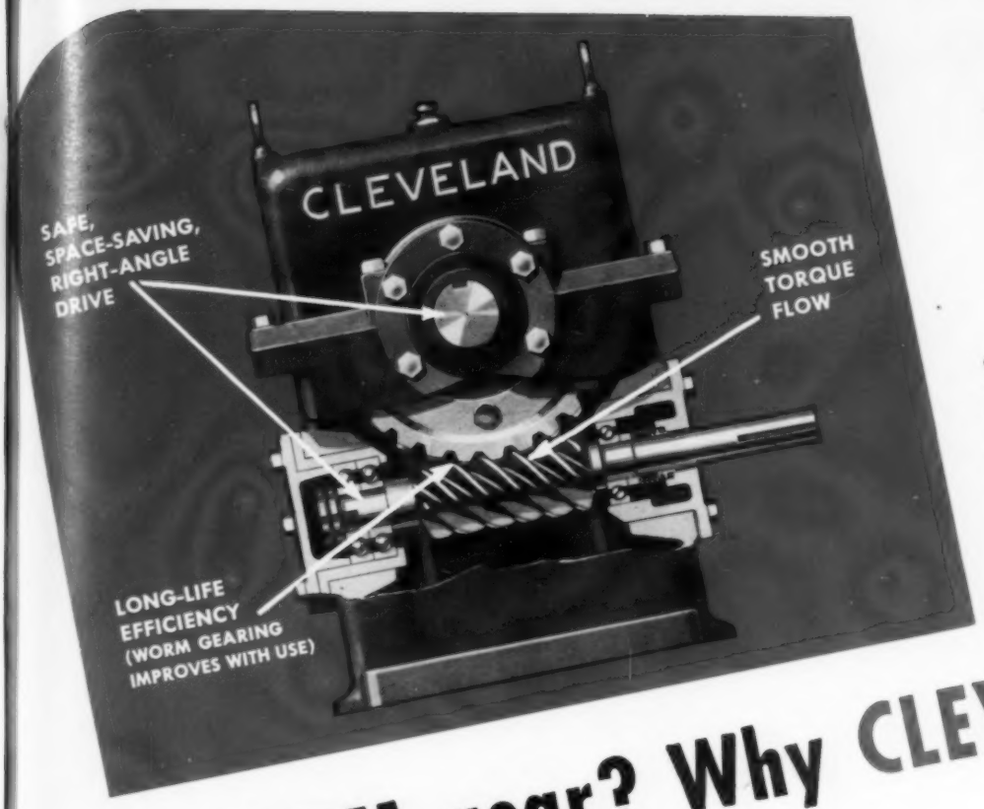

Cutaway shows compact interior design and construction of a typical Cleveland worm gear speed reducer, used in thousands of plants. Clevelands save floor space—are simple to install and maintain. A minimum number of moving parts practically eliminates trouble.

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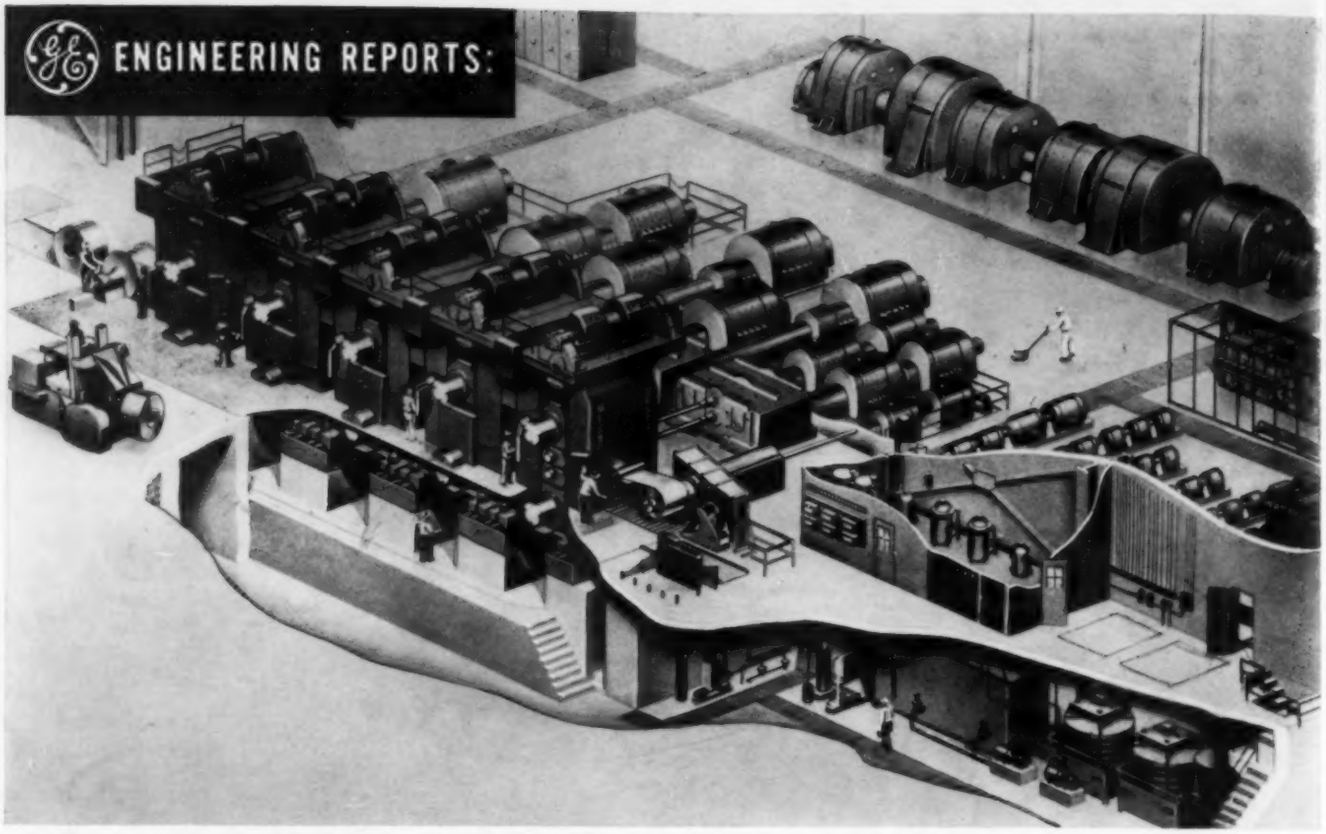
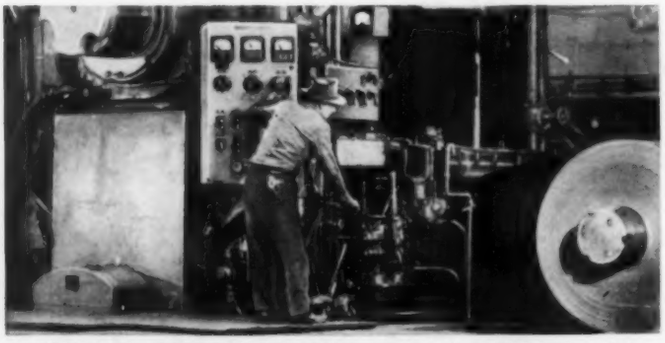


With the help of co-ordinated auxiliary drives, Jones & Laughlin's Aliquippa mill . . .

Sets new record for rolling cold strip

FOR FAST POSITIONING, screwdown motors are controlled by General Electric amplidyne adjustable-voltage systems.



AMPLISTAT-AMPLIDYNE CONTROL on this 600-hp reel drive was one of first magnetic amplifiers on a cold strip mill.

At Jones & Laughlin's five-stand Aliquippa cold-mill, steel has been cold-rolled at a record-breaking 70-mph. Acceleration from standstill to top speed takes less than 12 seconds.

To help make these speeds possible, the mill's G-E auxiliary drives were engineered as a complete system and carefully co-ordinated with main drives. Result: besides standing up to record rolling speeds, these auxiliary drives enable the mill to perform daily at speeds higher than the maximum speed of most installations.

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Whatever your mill's electric needs, General Electric steel-mill application engineers can help you or your consultants co-ordinate your electric equipment for top performance. For further information, contact your nearest G-E Apparatus Sales Office and ask for Bulletin GEA-5570, or write to General Electric Company, Section 659-93, Schenectady 5, N. Y.

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